

THE MENTAL REPRESENTATION OF SUBSTITUTES AND COMPLEMENTS:
TOWARD A THEORY OF COMPLEMENTARITY

By

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By

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This dissertation investigates the connection between consumers' cognitive structures and the economic relationships between products (complements/substitutes/independents). A schema-based cognitive structure is described, in which items that can instantiate the same variable in a schema are cognitive-substitutes, items that can instantiate different variables in the same schema are cognitive-complements, and items that instantiate distinct, nonoverlapping schemas are cognitive-independents.

A method of identifying such cognitive structures (or schemas) is described and is used to identify 18 separate schemas. The resulting stimuli are classified as cognitive (c)-substitutes, c-complements, and c-independents, and the correspondence between cognitive and economic (e-) relations is then experimentally verified for each of these 18 schemas.

The results strongly support the notion that c-complements are also e-complements, c-substitutes are also e-substitutes, and c-independents are also e-independents. A separate set of studies demonstrates that products which are perceived to be substitutes in one context may be viewed as complements in another context by the same consumers.

Taken together, the studies indicate that cognitive structures are an important asset toward developing a theory of complementarity and are worthy of further investigation.

CHAPTER 1 INTRODUCTION

Most prior research on inter-product relationships has focused primarily on the study of substitutes and substitutability, resulting in a relative neglect of the study of complements. Thus, for instance, the bulk of the work on similarity and choice models in marketing has focused on providing a better representation of substitutes. Comparable methods for representing complements simply do not exist. Nevertheless, researchers have shown an increasing interest in complements in the recent past (cf. Betancourt and Gautschi 1990; Foster 1992; Mulhern and Leone 1991; Walters 1991), and this dissertation is an effort to contribute to this emerging area of research, while at the same time accounting for substitution effects.

Knowledge of complementarities among products leads to directly actionable micro-strategies in marketing (cf. Vardarajan 1986). For instance, manufacturers and retailers would be able to plan cross-promotions (such as cross-coupons and price-bundling) more efficiently and profitably if they knew exactly which products were perceived to be complements by their customers (cf. Foster 1990). Another area where a thorough knowledge of complements would help is retail store layout. Conventional wisdom holds that placing products such as pretzels or chips near complementary products such as soft drinks increases their sales almost twice as much as when the chips are placed next to non-complementary products such as milk. In addition, retailers' awareness of substitutive/complementary relations among products is essential in order for them to offer a "good" assortment of products. Other, broader issues that may be influenced by knowledge of the perceived economic relationships between products may include brand extension decisions, which are more likely to be successful for perceived complements than for perceived

independents. Thus, the concept of complementarity is extremely important for researchers in marketing.

Since most of the seminal work on complementarity has been done by economists, the next chapter is devoted to a brief synopsis of the more important developments in economics relevant to the understanding of substitutes and complements. The literature shows that early researchers started out with utility-based conceptualizations of substitutability and complementarity, but later focused on cross-elasticity based definitions. While cross-elasticity based approaches are very helpful from an analytical standpoint, they do not help explain the causes of substitutability and complementarity; instead, they are axiomatic approaches. (Note that only the work related to the theory of consumer demand will be reviewed; production complementarity is not relevant to this dissertation, and will therefore not be reviewed here.)

Chapter 3 presents a review of the literature in marketing and psychology. This chapter will also provide a theoretical perspective for understanding the nature of the cognitive representation of substitutes, complements, and independent products. The central tenet of this dissertation is that cognitive structures predict perceived economic structures, and that such cognitive structures can be identified.

Chapter 4 details a method for identifying such cognitive structures, which are then verified experimentally in chapter 5, thus establishing that cognitive structures can and do predict perceived complements, perceived substitutes, and perceived independent products.

The basic idea of cognitive-structure, or schema-mediated complementarity and substitutability, also implies that products perceived to be substitutes in one schema may be viewed as complements in another schema, and vice-versa. Accordingly, Chapter 6 provides experimental demonstrations showing that two items perceived as substitutes in one context may be perceived as complements in another context and vice-versa, by the same consumers. This is followed by a summary and conclusion, including a discussion of future research opportunities stemming from this work.

CHAPTER 2 ECONOMISTS' VIEWS

Introduction

Niels Bohr is quoted by Folse (1985, 9) as saying "I think it would be reasonable to say that no man who is called a philosopher understands what is meant by the complementary descriptions." Bohr's words regarding his conceptual framework for viewing quantum theory seem to apply just as much to the problem of product complementarity. Thus, for instance, Newman (1987) bemoans the fact that economists have found it hard to deal with the problem of complementarity. His grouse is that economists have *too many* definitions of this construct, each with its own advantages and disadvantages. Nevertheless, he goes on to stress the importance of complementarity to microeconomic theory and then proceeds to review the various definitions and their underlying history.

This chapter, too, is an attempt to review the development of the complementarity construct in economic thought from the nineteenth century to the present day. The review is however restricted to the literature on complements and substitutes as it relates to the theory of consumer demand, and will not include the production aspects. The discussion will begin with the early, more intuitive definitions and will then outline some of the more recent and abstruse definitions.

The Early Definitions

The view that one good may be used instead of another (that is, the goods may be substitutes) or that one good may enhance another (the two goods may be complements) has been known since time immemorial. However, the responsibility for having first

introduced formal definitions for these concepts has been attributed (Newman 1987) variously to Fisher (1892, 1925), Edgeworth (1897), and Pareto (1927). Stigler (1965) and Newman (1987) point out, though, that the credit rightly goes to the Viennese bankers Auspitz and Lieben¹.

Auspitz and Lieben identified two goods to be substitutes, complements or independent of one another depending on the relationship between the utilities of the two goods. Thus, for the two goods x and y , if

$U_{xy} > 0$, then x and y are complements,

$U_{xy} < 0$, then x and y are substitutes, and if

$U_{xy} = 0$, then x and y are independent

where $U_{xy} = (dU / dx).(dU / dy)$.

Thus, if $(d^2U) / (dx.dy) > 0$, then x and y are complements.

That is, if an increase in the consumption of good y results in increased marginal utility of good x , then x and y are complements. Similarly, if the left hand side of the equation above is negative, then x and y are substitutes, since this implies that an increase in consumption of good y results in decreased marginal utility for good x . Finally, if the term in the above equation is equal to zero, then x and y are independent, since the increased consumption of y does not affect marginal utility for x .

Using a similar definition, Fisher (1892) defined two goods to be substitutes if the ratio of the marginal utilities of the two amounts consumed was constant. That is, if $(dU / dx) / (dU / dy)$ is a constant ratio, then goods x and y are substitutes. This ratio is the marginal rate of substitution of y for x ; that is, the ratio at which y may be substituted for x while still maintaining the same utility level. In contrast, Fisher defined goods to be perfect complements if the quantities consumed were in a constant ratio -- the same criterion given later by Edgeworth (1897, 1925).

¹ Newman (1987) cites R. Auspitz and R. Lieben as the originators of a formal definition for substitutes and complements, based on their book Untersuchungen über die Theorie des Preises, published in 1889 (Leipzig: Duncker and Humblot).

Samuelson (1974) has explained these definitions by way of an example. The simplest case is the "either-or"/ "both-and" definition for substitutes and complements, respectively. To illustrate using Samuelson's examples, one might desire a hot cup of "something" at Four 'o' clock, and one could have a cup of coffee, or, failing that, tea. In this case, the two are substitutes. In contrast to this, one might desire a cold cup of tea, and could add a squeeze of lime - in this case, tea and lime are being consumed together, and they are therefore complements. Samuelson credits such a definition of complements by showing "perfectly polar" cases to Fisher (1892).

Expanding on this stream of thinking, Samuelson (1974) considers the case where one possesses a collection of goods. Adding tea to this preexisting group could make one better-off, and so might adding a squeeze of lime. However, adding both together gives rise to benefits greater than the sum of their separate benefits, hence tea and lime are complements. Similarly, tea and coffee together give rise to less satisfaction than the sum of the benefits from consuming the two separately, hence the two are substitutes. This second definition has been termed the "Pareto-Georgescu criterion" by Samuelson after the work of Pareto (1909) and Georgescu-Roegen (1952).

A closely related third definition is based on the sign of *ceteris paribus* cross-elasticities. Thus, if the rise in price of a good " x " causes demand for good " y " to go up, x and y are substitutes, and if the rise in price of x causes demand for y to go down, then they are complements. This last definition is at least implicitly present in the earlier two definitions, and obviously is tantamount to the Auspitz and Lieben definition. For this reason, Newman (1987) has termed all of the above as the Auspitz-Lieben or A-L definitions.

These A-L definitions are intuitively appealing. Another property of these definitions is that they are symmetrical ($U_{xy} = U_{yx}$). Thus, if y is complementary to x , then x must be complementary to y . Though this property is mathematically desirable (and therefore may be viewed positively by economists), it may be viewed as a shortcoming by

marketing researchers, since such symmetry is not necessarily present in real life. For example, Walters (1991), and Mulhern and Leone (1991) noted an asymmetry in the complementarity observed empirically between cake mix and cake frosting. They found that the sales of frosting increased above the base-line after a reduction in the price of cake mix, whereas the sales of cake mix did not increase significantly following a reduction in the price of frosting.

The third property of the A-L definitions is that they depend only on the pair of commodities and the decision-maker, so that they are seemingly "context-free". However, several studies have shown that perceived substitutability, at least, depends on the context in which the goods are perceived. However, the criticism that is the most damning (in the eyes of economists) is related to the mathematical properties of the definitions, and the possible confusion arising from mathematical transformations of these definitions, as explained below.

The utility function (U_{xy}) used in the A-L definitions can be transformed so that $V = F(U)$, where $F' > 0$. Recall that $U_{xy} = (d^2U / dx \cdot dy)$. Hence, if $V = F(U)$, then $V_{xy} = (d^2V / dx \cdot dy) = d[F'(U_x)] / dy$

$$\begin{aligned} &= (dF / dy) \cdot (d^2U / dx \cdot dy) + (d^2F / dy \cdot dx) \cdot (dU / dx) \cdot (dU / dy) \\ &= F'(U_{xy}) + F'' U_x U_y \end{aligned}$$

Thus, depending on the choice of F , the sign of U_{xy} can be changed. For instance, by making F very convex, F'' will be positive and large, so that a negative U_{xy} amounts to a positive V_{xy} . The problem here is that by choosing a very convex function F (where $V = F(U)$), it is possible to convert substitutes into complements or vice versa mathematically. Thus substitutes can become complements or complements substitutes depending on the choice of F , rather than a change in the decision makers' tastes. This is possible because absolute utility values are not known, and only ordinal preferences are considered by the A-L definitions.

In Newman's (1987, 546) words, this is ... "a fatal flaw. The A-L definitions are therefore meaningless in any theory of demand that abandons cardinal utility". The work that followed these earlier (A-L) definitions includes the similar (but independently performed) work by Johnson (1913), Slutsky (1915), and Hicks and Allen (1934). Johnson (1913) overcame the transformation related problems of the A-L definitions by using the marginal rate of substitution. He defined the marginal rate of substitution of y for x as V , where $V = (U_x / U_y)$, and the inverse as W (that is, $W = V^{-1}$). Using these terms, Johnson defined x and y to be complements if (dV / dx) and (dW / dy) were negative, and to be substitutes if either of the two terms were positive.

Since $V = (U_x / U_y)$, $dV / dx = (U_{xy} - U_x U_{yx}) / (U_y)^2$.

Now, in the above equation, U_{xy} is always negative, and $(U_y)^2$ is always positive. Hence, for the right side of the equation to be always negative, U_x and U_{yx} have to have the same sign. U_x is always positive (by definition). Hence, U_{yx} has to be positive for dV / dx to be negative. That is, x and y are complements if U_{yx} is positive. Similarly, x and y are substitutes if U_{yx} is negative. Note that this is similar to the A-L definitions, but that Johnson's definitions do not have the "critical flaw" present in the A-L definitions. Thus, Johnson's (1913) definitions are invariant to permissible transformations of the utility function U . However, they give rise to symmetrical relationships as before.

Having discussed the older (and relatively intuitive) definitions of complements and substitutes in economics, we come to the narrower, more specialized definitions. Newman (1987) has provided a complete account of these definitions, which are provided below in brief.

Modern Definitions

Hicks-Allen

The standard definitions used in textbooks today can be traced directly to the work of Hicks and Allen (1934). Their research is regarded as the basis of the theory of consumer demand, and indeed, of much of modern microeconomics. They provided a definition dependent on the "Hicksian Demand Function" (h_i) for the i^{th} commodity given by

$$\forall i, h_i(\omega|b') = \delta c(\omega|b') / \delta \omega_i$$

where $h_i(\omega|b')$ is the i^{th} good when the target bundle is b' and the vector of normalized prices is ω , and c denotes cost (or expenditure), which is a concave function of normalized price of the target bundle, so that $\delta c(\omega|b') / \delta \omega_i$ denotes change in expenditure for a small change in normalized price of good i , where ω is the normalized price calculated for the target bundle b' .

Hicksian demand is, by definition, a compensated demand; that is, it allows the consumer to stay at the same utility level. Using the Hicksian demand function, Hicks and Allen (1934) defined good x to be a net substitute for good y if $[h_x(\omega|b') / d\omega_y] > 0$ where h_x is the Hicksian demand for good x .

Thus, if the normalized price of good y increases and this causes Hicksian demand for good x to increase, then x and y are substitutes. Similarly, x is a net complement of good y if the above inequality is reversed, and if it is an equality, then x and y are net independents.

Samuelson (1974) has shown that the price normalization used by Hicks and Allen (1934) is theoretically equivalent to studying cross-price elasticities while keeping the consumer at a constant utility level. Thus, when the price of good y is raised, the money income of the consumer is also raised by a sufficient amount to keep the consumer on the same indifference contour after which the demand for good x is assessed:

$$(\delta q_x / \delta p_y)_u = (\delta q_x / \delta p_y) + q_y (\delta q_x / \delta \text{income}) = S_{xy} = S_{yx}$$

where x and y are the goods in question, q is the quantity demanded, p is the price, and the subscript u denotes the constant utility curve. The term on the left side of the equation denotes change in quantity of x demanded for a small change in the price of y , keeping the utilities constant for x and y , and the first term on the right side of the equation $(\delta q_x / \delta p_y)$ is the effect of the change in price of y on the quantity of x demanded (also known as the "substitution effect"), and the next term $q_y (\delta q_x / \delta \text{income})$ calculates the quantity of y and x demanded as a result of the change in income (also known as the "income effect").

Samuelson has shown that $S_{xy} > 0$ implies that x and y are substitutes, $S_{xy} < 0$ implies that x and y are complements, and $S_{xy} = 0$ implies that x and y are independent. One result of this definition is that in a universe with only two goods, the two goods must be "Hicks-Allen substitutes". Similarly, in the three-good case, at most one pair of goods can be complements, and so on, as originally proved by Hicks and Allen (1934). Another property of this definition is that this definition is symmetrical, so that if x is a complement of y , then y is also a complement of x .

Hicks-Deaton

This definition involves the use of the inverse Hicksian demand function and is based on a generalization of Deaton's (1979) distance function $k(b|b')$:

$\forall i, \omega = \delta k(b|b') / \delta b'$. Denoting inverse Hicksian functions by H_i (for the i^{th} good) gives:

$$\forall i, H_i(b \setminus b') = \delta k(b|b') / \delta b_i$$

That is, for all i , inverse Hicksian demand for good i (given better set " b " and target bundle " b' ") is equal to the small change in utility of the bundle consumed given a small change in the quantity of good i in the bundle consumed. Note that in this (Hicks-

Deaton) formulation, price is defined as a function of quantity demanded, whereas in the earlier (Hicks-Allen) formula, quantity demanded is a function of price.

The Hicks-Deaton view holds that a good x is a "q-substitute" for y if $\delta H_x(b|b') / \delta y < 0$, a "q-complement" if the expression is less than zero, and "q-independent" if it is equal to zero. That is, if a small increase in the quantity of y consumed causes inverse Hicksian demand for x (H_x) to decrease, then x is a "quantity-substitute" for y .

Newman (1987) has shown that this definition, too, is symmetrical, so that if x is a "q-complement" for y , then y is a "q-complement" for x . However, the Hicks-Deaton formulation is based on a "dual" of the function that is the basis of the Hicks-Allen formulation. As a result, in a Hicks-Deaton world, q-complements predominate, so that in the two-good condition, there can never be q-substitutes. This is thus the mirror-opposite of the Hicks-Allen result.

Samuelson

Yet another definition has been developed by Samuelson (1974), using a measure of "money metric" complementarity. According to this definition, a good x is a substitute/independent/complement of good y depending on whether $\delta^2 c(\omega|b') / (\delta x, \delta y)$ is negative/zero/positive respectively, where the variables have the same meaning as before. That is, $\delta c / \delta x$ is the change in expenditure for the bundle of goods consumed given a small change in the quantity of x demanded, and $\delta^2 c / (\delta x, \delta y)$ is the change in the above term given a small change in the quantity of y demanded. (Thus, $\delta^2 c / (\delta x, \delta y)$ is the rate of change of expenditure due to the quantity of x consumed as a result of a small change in the quantity of y consumed).

Note that this definition depends on the behavior of minimized cost as the target bundle b' is varied (unlike the earlier definitions, where the target bundle was assumed to be fixed and given exogeneously). This definition is symmetrical, as were all the

definitions mentioned earlier. This measure does not appear to have many adherents (Newman 1987).

Mosak

Mosak (1944) had earlier developed a very different measure of complementarity, wherein he defined "gross complements" and "gross substitutes". Using individual Marshallian demand functions (M): $M_i = f_i(p, w)$, where w is the individual i 's wealth and p is the normalized price, Mosak called a good x a gross substitute for y if $\partial f_x(p, w) / \partial p_y$ were positive, a gross complement if negative and gross independent if equal to zero. Here, the term denotes change in Marshallian demand for good x given a small change in the price of good y . Note that in the Hicksian demand function, one minimizes expenditure subject to a utility constraint so as to achieve a level of utility greater than or equal to a set "minimum" level of utility. In contrast, in Marshallian demand, one maximizes utility subject to a budget constraint.

Newman (1987) has shown that Mosak's definition is not symmetrical, so that by this definition, it is possible for x to be a gross complement to y and y a gross substitute to x . As such, it is the only definition of all the ones discussed so far that permits such asymmetry. However, the meaning of such asymmetry is non-intuitive and has been referred to as "a strange set of affairs" by Newman.

At this point, it should be noted that all of the definitions mentioned above assume a negatively sloping demand curve; that is, it is assumed that if the price of a good increases, ceteris paribus, the quantity purchased (or demanded) will decrease. However, there are two cases where this assumption may be invalid, both of which may lead to wrong conclusions about the nature of inter-product relations if measures of cross-price elasticities alone were to be used to judge such relationships, as explained below.

Cases of Positively Sloping Demand Curves

For instance, Stigler (1965) has mentioned the "Giffen paradox" with this example: A rise in the price of bread may make so large a drain on the resources of poor families that they consume less of the more expensive foods (such as meat). Thus, while bread and meat may actually be substitutes in the either-or sense, they appear to be complements in terms of their cross-price elasticities. This paradox was resolved by Johnson's (1913) work and later definitions by assuming a normalized measure for prices, so that the consumer remains on the same indifference curve in spite of the increases in price. While this is theoretically elegant, it does not remove the problems in using cross-price elasticities to infer complementary/substitute relationships.

Another example of a positively sloping demand curve is the case of snob or Veblen goods. For example, consider the case where a person likes diamonds mainly because they are expensive. In such a case, the more expensive the diamonds, the greater the demand for them. Such cases do not appear to be amenable to most of the definitions above, though they can be handled by suitable definitions of utility. This example, too, demonstrates a possible shortcoming of the use of cross-price elasticity alone in gauging complementarity.

Conclusion

One common thread running through this discussion so far is some implicit notion of negative cross-price elasticity as a basis for calling goods complements. Overall, though, one comes to the conclusion that there is no single, clear and concise definition of complementarity to fit all the cases. Thus, it comes as no surprise that Samuelson (1974) considers complementarity a "complicated" concept. Another point that stands out is that most definitions of this concept have focused on the substitutability angle. Much of modern microeconomics, too, is based on notions of substitution, probably because it has been built on the definitions of Hicks and Allen, which cannot explain complementarity in the two-good case.

This may also be one of the reasons why researchers in marketing and consumer behavior have studied substitutes to a far greater extent than complements. Admittedly, it is important to know as much as possible about substitutes as they represent a potential *threat* from the managerial perspective. However, it is also important to know as much as possible about complements as they represent a potential *opportunity*.

The next chapter of this dissertation will try to remedy this situation (of neglecting complements) and will focus on the study of complements. Consumer behavior is often the study of a process, whereas economics has been historically concerned with outcomes. Proceeding in the tradition of consumer behavior research, this dissertation will propose a new view of the mental representation of complements and substitutes, thus increasing our understanding of these concepts. As such, then, this work should be viewed as "complementary" to the aforementioned literature in economics.

CHAPTER 3 THE DETERMINANTS AND REPRESENTATION OF COMPLEMENTARITY

Introduction

Economists are virtually the only group of organized researchers who have studied the concept of "complementarity"; in fact, as shown in the previous chapter, they have defined the concept. Substitutes have been studied to a much greater degree, and this focus on substitutes has been carried over into marketing. That is, researchers in marketing and consumer behavior have also focused on substitutes far more than on complements.

For instance, there are now a myriad different and well-documented studies exploring the determinants and representation of substitutability (cf. Ratneshwar and Shocker 1991; Day, Shocker, and Srivastava 1979; Srivastava, Alpert and Shocker 1984). Thus, it is now well established that substitution effects are prevalent and that it is important to study them.

For example, recent work by Hutchinson, Raman and Mantrala (1994) has offered a Markov model depicting memory processes; this work, too, focuses mainly on memory for substitutes (see Nedungadi 1990; and Alba, Hutchinson, and Lynch 1991 for other examples of memory-based approaches to the study of substitutes).

One can even determine the "degree of substitutability" among products. Such research (cf. Srivastava et al 1984; Fennell 1978; Lutz and Kakkar 1975) has also driven home the point that substitutability is a matter of context: that is, it is *not* an inherent property of goods, but instead depends on how the goods are *used*.

In contrast, very little work has been done on complementarity. In fact, the term itself (as an analog to substitutability) is virtually unknown. Current research in marketing draws on previous research in economics, so that complements are defined (and identified)

by cross-price elasticity. Srivastava et al. have noted, however, that using cross-price elasticity has its drawbacks. For example, "real" cross-price elasticity is hard to measure, since firms routinely change prices in response to changes by competitors. Even more important, perhaps, is the fact that using cross-price elasticity does not help a person discern the nature of relationships between products (e.g. substitutes as opposed to complements) *before purchase*. Nor does cross-price elasticity offer any explanation of the determinants of complementarity. This is because cross-price elasticities are a result of complementary (or otherwise) relationships between entities: the elasticities do not determine - or give rise to - complementarity.

What is needed is some theoretical underpinning for the complementarity concept - a theory that will help us understand how complementarity arises. A definition of complementarity is, of course, an essential starting point. I will define complements using the notions originally developed by Fisher (1892). Thus, two goods will be considered to be complements if their utility together is greater than the sum of their individual utilities, to be substitutes if the combined utility is less, and independent if the combined utility is equal to the sum of the parts. Thus, cardinal utility is assumed.

This dissertation will present a psychological framework to help explain the nature and mental representation of complements and substitutes. This will then be developed into a new method of generating substitutes and complements. This method will then be tested using the ancient and well-established concepts in economics developed by Fisher. Finally, this dissertation will show that complementarity is context-dependent; a point that has not been experimentally demonstrated in the literature.

As shown above, substitutes have been studied extensively, whereas complements are only now beginning to come under scrutiny. Probably as a result of this, there is no unitary theory to explain the division (or categorization) of products into substitutes, complements and independent goods. To this end, some concepts may be gainfully

borrowed from recent categorization research in psychology. In particular, the work of Barsalou (1982, 1983, 1985) seems to be highly relevant to the problem at hand.

Barsalou (1982) proposed that concepts contain two types of properties: context-independent and context-dependent. Context-dependent properties of an object/activity are those that are not activated by mentioning the entity independent of the context, whereas context-independent properties are those which are activated regardless -- i.e. independent -- of the context. For example, Barsalou noted that "floats" is a property that does not ordinarily come to mind when one thinks of a basketball. However, if one were to read that a person who fell overboard from a ship hung on to a basketball until rescued, the property "floats" would be apparent. Thus, the property "floats" would be considered a context-dependent property of basketballs.

Applying such propositions to the problem of complementarity, one should note that in most cases, objects or entities are complements (or substitutes or neither) depending on the context in which they are viewed, since complementarity refers to a relationship in a given context. In Barsalou's terms, we would say that complementarity is context-dependent.

This idea is not new to marketing and consumer research, where usage contexts have been viewed as the relevant contexts. Usage contexts define consumers' goals, thus to some extent defining the means (products) that can be used to obtain such goals (cf. Belk 1975; Dickson 1982; Gutman 1982; Ratneshwar and Shocker 1991). The review of Barsalou's work in categorization theory is continued below.

Ad-hoc and Goal-Derived Categories

Barsalou (1983, 1985) later defined "ad-hoc" and "goal-derived" categories, where ad-hoc categories are categories consisting of items to be used for a novel or unusual goal. Thus, he defined categories such as "things to take from one's home during a fire" and

"ways to escape being killed by the Mafia" as ad-hoc categories. Barsalou (1983) showed that ad-hoc categories possess typicality gradients as reliable as those in the case of taxonomic (common) categories. His later work in trying to determine the determinants of typicality (Barsalou 1985) in taxonomies versus goal-derived categories showed that family resemblance predicts typicality in taxonomic but not in goal-derived categories.

The very term "goal-derived" is akin to hypothesizing in marketing about goals defining consumers' contexts. Several researchers have used substitution-in-use as a means of identifying substitutes (e.g. Day, Shocker, and Srivastava 1979; Srivastava, Alpert and Shocker 1984). Similarly, Holbrook and Lehmann (1981) have conceptualized substitutes as items meeting specific needs and complements as items meeting more broadly defined needs, and it seems that the term "goals" could be used instead of "needs" without any dilution of their conceptualization. Thus, one type of complementarity may be defined as "goal-derived complementarity", wherein objects are complementary because they are (conjunctively) necessary for achieving some goal.

Goal-Derived Complementarity

Becker (1976) and Lancaster (1971) have theorized that consumers derive utility from the characteristics that goods possess rather than the goods themselves. Thus, consumers have needs or goals, and they utilize or consume goods and activities so as to achieve their goals. All goods/entities consumed conjunctively so as to achieve a particular goal may be viewed as goal-derived complements.

Drawing on the work of Barsalou (1983, 1985), one could consider two types of goal-derived complements: ad-hoc and well-defined. If objects are *not* normally used together (or considered necessary) to achieving a goal, then they may be considered as ad-hoc complements. On the other hand, if objects are normally used together to achieve a particular goal, then they may be considered well-defined complements.

A special case of goal-derived complements is the case of variety-seeking. For instance, Lattin and McAlister (1985) have noted that in some product classes, consumers are likely to be variety-seekers. Thus, several brands within a product class may be complementary from the point of view of a consumer whose desired goal is variety in consumption. Lattin and McAlister have developed a variety-seeking model to identify substitute and complementary relationships among products that are normally thought to be substitutes by virtue of being in the same product category.

Partonomies

Another way to look at complements may be to look at an object/event/ entity as a whole, and then to break it up into meaningful parts, where each part would be a complement to every other part. Such a version of complementarity could be called "partonomy-derived complementarity" after the work of Winston, Chaffin, and Hermann (1987) in "partonomies".

Their research follows that of Tversky and Hemenway (1984), who have pioneered the study of "parts" and the "wholes" that they constitute. Tversky and Hemenway (1984) have noted that perceptual salience and functional significance of objects both contribute to "part goodness", which they hypothesize to be an important factor underlying categorization.

According to these authors, a knowledge organization by parts (also termed "partonomy") serves to separate objects into their structural components. Tversky and Hemenway have contrasted taxonomical and partonomical organization by using the example of automobiles.

Specifically, they state that in a taxonomical organization, sedans and station wagons would be classified as kind of automobiles whereas looking at one automobile in a partonomy, an engine, wheels, and doors are parts of one automobile. Note that the engine, wheels and doors are obviously complements in this case, whereas the different

kinds of cars seem to be substitutes. Thus, it would seem that taxonomies are a way of portraying substitutes and partonomies are a way of portraying complements. Barsalou and Sewell (1985) have commented that object partonomies and taxonomies also seem to differ in that the partonomies are dimensionally organized in terms of spatial position.

Partonomies have been studied in greater detail by Winston, Chaffin and Hermann (1987), who have, in fact, offered a classificatory scheme of part-whole relations that is very relevant to the quest of defining complementary relations. Winston et al have focused on the recent work in linguistics, cognitive psychology and philosophy to develop their taxonomy of part-whole relations. (In linguistic terms, part-whole relations are "meronymic"; Winston et al have therefore called their study a study of meronymic relations). The classes mentioned by Winston et al include: (1) Component-Object, (2) Item/Collection, and (3) Event/Activity. These classes are explained below.

Component-Object.

This class contains parts that are complements in the way that parts of a car are complements. Thus, the components (parts) here would be things like tires, engine, seats, etc., while the object (or whole) would be a car. As can be seen from this example, when any object is broken down into its parts, they are all complements of each other. However, different examples for a particular part would be substitutes (for example, Michelin versus Goodrich tires).

Member/Collection.

Membership in a collection confers a complementary relationship. Markman's (1981) work in developmental psychology on collections would come under this class. Thus, playing cards are complementary to one another by virtue of their being co-members of a deck of playing cards. (The value of the cards in conjunction with one-another is obviously much greater than the sum of the value of each individual card).

This class consists of items (parts) that form a collection (whole). For instance, every coin in a rare coin collection is a complement to the rest of the coins (unless it is a

duplicate). The complementarity is easily evident when one looks at the last rare coin "needed to complete" the collection - the sum of the utility of separately owning the last coin and that of the rest of the collection is less than the utility derived from owning the whole collection.

Event/Activity.

An example of this class is that of the events making up the activity "going to a restaurant". The idea is that each of the components of the activity are complementary to each other. For example, we go to a restaurant, are seated by a host/hostess, place our orders, start with appetizers, followed by salad, followed by the meal, followed by dessert, after which we might have a cup of coffee. We then ask for the check, pay the bill, and then leave.

Each of these activities is complementary to one-another. Also, this particular example shows a temporal-order. That is, the complementarity (or enhanced utility) for the cup of coffee is much greater at the end of the meal than in the middle for most people. Thus, in addition to the properties of the earlier classes, this class often has the additional property of complementarity related to order of consumption. This idea of a temporal order to a scheme of events (and indeed, the entire example) is also an excellent example of a class of schemas known as "scripts".

Scripts have been studied extensively by Schank and Abelson (1977). The script concept refers to general and specific information concerning specific, familiar events. Schank and Abelson (1977) have defined a script as a structure that describes appropriate sequences of events in a particular context. A script is made up of "slots" with requirements about what can fill the slots. A script is an interconnected whole, so that what is in one slot affects what can be in another. A script is thus a predetermined, stereotyped sequence of action defining a well-known situation.

At this point, it should be noted that scripts are special cases of more general knowledge structures known as schemas. In fact, partonomies are also examples of

schemas, as are other categories such as goal-derived categories. Thus, it would appear that all complementarity is schema-driven. A brief review of the schema literature is presented below.

Review of the "Schema" Concept.

Bartlett (1932) is generally credited with the first usage of the schema concept. He defined a schema as "an active organization of past reactions, or of past experiences, which must always be supposed to be operating in any well-defined organic response" (page 207). After a long hiatus, researchers in cognitive psychology and artificial intelligence began studying schema theories in the mid-seventies. However, researchers do not have one single definition for the term "schema". Thus, Rumelhart (1980) has defined a schema as a "data structure for representing the generic concepts stored in memory" (page 34), whereas Neisser (1976) had earlier speculated that schemas could be a part of the nervous system and might be related to "physiological structures and processes" (page 54). One thing that all researchers appear to be agreed upon is that there is no single, concrete accepted definition for schemas.

However, of late researchers have adopted a relatively broad meaning for schema of the type given by Graesser and Nakamura (1982) which is similar in spirit to Rumelhart's definition above: a schema is a generic summary of the components, attributes and relationships that typically occur in specific exemplars. A schema consists of knowledge, in that its properties usually apply to its referent. Schemas are highly structured and their constituents are spatio-temporally linked.

Schemas are typically viewed as wholes that are made up of empty spaces that will eventually be filled up as the schema guides comprehension of specific input (cf. Graesser and Nakamura 1982; Minsky 1975; Rumelhart and Ortony 1977). Unlike schema theory as a whole, two types of schemas that are relatively well-defined are frames and scripts (Alba and Hasher 1983).

Frames

The concept of "frames" was introduced by Minsky (1975) to denote schemas containing knowledge about the structure of a familiar event. Minsky has described a frame as a data-structure for representing a stereotyped situation. Frames are hypothesized to be a network of nodes and relations, where the top levels of a frame are fixed, representing things that are always true in a given situation. The lower levels are hypothesized to have many terminals or "slots" which will be filled with specific instances. Thus, this definition of a frame is similar to the definition of "script" offered later by Schank and Abelson (1977).

While I have mentioned only two specific cases (frames and scripts), schemas have been used to represent many different knowledge domains. For instance, schemas for person stereotypes have been described by Hamilton (1981) and Taylor and Crocker (1981), schemas for goal-oriented action sequences have been described by Nelson (1977), spatial scenarios by Brewer and Treyens (1981) and so on. In addition to frames and scripts, several terms have been developed to show the properties of different types of schemas (depending also on the research background of the developer), for example, stereotypes, themes, macro-structures, models, and memory organization packages (MOPs).

The concept of schemas has been used to form schema theories to explain memory related phenomena such as remembering and forgetting. Alba and Hasher (1983) have reviewed schema theories extensively and have proposed a prototypical framework for such theories. Their framework assumes that a schema (based on prior knowledge) influences memory in four central encoding processes. Specifically, selection of new information (for encoding) is influenced by the preexisting schema. This selected information is then further reduced by a process of abstraction, so that only this abstracted information is then interpreted according to the schema and the resultant information is integrated to form a single, holistic representation.

Alba and Hasher (1983) have suggested that memory for complex events is far richer than schema theory allows, and that at least some details are stored regardless of a person's prior knowledge. Finally they have noted that a variety of nonschematic concepts are available to explain observed memory phenomena. Thus, they have concluded that memory representation is not fully captured by schema theory.

This conclusion of Alba and Hasher has been debated by Mandler (1984). She has stated that, on the one hand, Alba and Hasher base their conclusion on the assumption that only one schema is activated at a time. On the other hand, she notes that several schemas can be activated simultaneously, thus accounting for the richness of memory representation. Thus, schema theory continues to be debated by researchers.

Schema-Derived Complements

It should be noted that I use "schemas" to mean either abstract structures or retrieval cues; both usages are consistent with Alba and Hasher (1983). I shall therefore sidestep further discussion of the above debate and focus on the notion of schema-driven complementarity. For instance, several researchers have noted that people have an "office-schema" which includes objects normally found in offices, such as typewriters, paper-clips, desk, executive chairs, filing cabinet and so on. Thus, a person with a visuo-spatial office-schema is likely to feel that there are "and" relationships among all of the above (typewriter, paper clips, etc.), thus making them complements. Thus, it may well be that persons may feel that there is super-additive utility in having a desk, chair, a filing cabinet and a typewriter in an office, thus making these items complements.

Schema-driven complementarity may thus be used to describe complementary relationships that are idiosyncratic to a person. For example, a person may believe that dark-colored shirts should be worn only with light colored trousers or that certain kinds of jeans can only be worn with boots - these examples would be instances of a person having

a schema of "what goes with what"; thus, they are examples of schema-derived complementarity.

When viewed at from this perspective, it is clear that partonomy and goal-derived complements are basically schema-derived complements. While the classes "goal-derived" and "partonomy-derived" are not identical, there is quite a bit of overlap among them. However, between the two of them, they seem to explain all complementarity. In this sense, the explanation of complementarity is rather broad, but it does offer some explanation of complements *a priori*, as opposed to a post-hoc, definitional approach as used by Economists. The routes to complementarity are shown in Figure 1.

The basic idea, then, is that perceived complementarity among objects (or entities) arises from the way these entities are organized in memory, i.e., from the nature of the schema possessed by the perceiver. Specifically, if the items fit into different slots in the same schema, then they contribute to the completion of the schema, thus providing utility over and above their context-independent utility. Similarly, entities are perceived to be substitutes depending on the way they are organized in memory. Thus, items which could fit the same slot in a given schema are substitutes, because once a slot is filled, a second instantiation for the same slot provides little additional utility from the perspective of completing the schema.

Note that this view of substitutes and complements makes it possible to infer economic relationships. For instance, assume that you *know* that products A_1 and A_2 are viewed as substitutes by a particular consumer. Also, assume that product B_1 is viewed as a complement to A_1 . Will this knowledge help determine whether B_1 is viewed as a substitute /complement to A_2 ? Similarly, if B_2 is viewed as a complement to A_2 , will B_2 be viewed as a substitute/complement to A_1 ? Finally, can one infer anything about the relationship between B_1 and B_2 ?

Knowledge of the cross price elasticities of (A_1, B_1) and (A_2, B_2) typically will not help us understand the relationship between B_1 and B_2 (at least, not without knowing

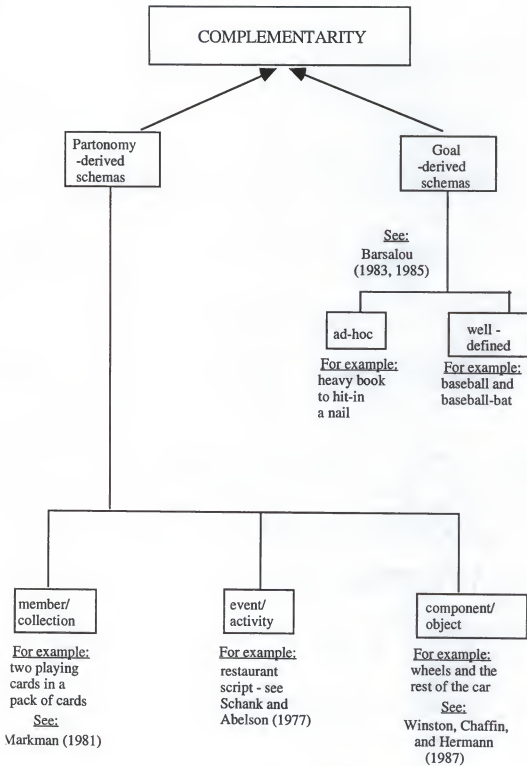


FIGURE 1
 THE SCHEMAS LEADING TO COMPLEMENTARITY

whether the entities co-occur in a given schema). This is because cross-price elasticities are a result of the economic relationship between entities (i.e., substitutes, complements, independents): the elasticities do not determine these relationships. However, the mystery is solved if one looks at the problem in terms of the schema theory developed herein. Thus, if the relevant schema contains slots "A" and "B", and A_1, A_2 are instantiations of the same slot (A), and likewise, B_1, B_2 are instantiations of slot "B", things begin to (almost literally!) fall into place. In this example, then, one would know that A_1 and A_2 are substitutes, and that B_1 and B_2 are substitutes. Similarly, a pair consisting of an instantiation of one slot and another from another slot in the same schema would be complements. That is, the pairs (A_i, B_j) are complements (i varying from 1 to 2). This idea is very different from the views on mental representation published by researchers in marketing, which are reviewed below.

Previous Representations Underlying Assumptions in Marketing

Related to the question of transitivity is the question of dimensionality. That is, can one posit that there is an underlying dimension of "substitutability" or "relatedness"? At first glance, it may seem that similarity could be used as a dimensional variable to explain the relationship among substitute, complementary and independent products. For instance, Lancaster (1966) has suggested that goods with similar features tend to be substitutes. In this sense, one would expect knowledge of psychological distance to help capture the relationship between products/services, by using multidimensional scaling methods such as those developed by Shepard (1962) and Carroll and Chang (1970). Researchers in marketing, too, have used similarity to define substitutes, especially in an attempt to depict market structure. For example, Day, Shocker, and Srivastava (1979) mention analyses of perceived substitutability as a means of determining market structure, and state that substitutability is a matter of degree.

Holbrook and Lehmann (1981) have, however, cautioned against such an MDS approach to conceptually link economics to psychology. They have noted that consumers judge items to be similar either because the items possess the same characteristics (substitutes) or because they see the items as fitting together in a larger pattern of consumption (complements). Thus, they note - citing the work of Day, Shocker and Srivastava (1978) - that an MDS analysis of typical pairwise similarity data is likely to be uninformative as regards the ability to discriminate between complements and substitutes.

Holbrook and Lehmann also note that in trying to correct this, Day et al (1978) derived perceptual maps for using evaluations of products' appropriateness of usage in different usage situations. While this may be viewed as an advancement over using evaluations unconstrained by usage situation, Holbrook and Lehmann contend that this method still suffers from the shortcomings Day et al themselves had pointed out. To illustrate the point that shared "appropriateness" may reflect complementarity just as easily as substitutability, Holbrook and Lehmann (1981) have given the example of coffee and cream - usually regarded as complements, though they are both used in the same usage situation.

It should be noted that for the most part, researchers in consumer behavior and marketing have looked at usage situations and substitution-in-use to get a feel for degree of substitutability (cf. Day, Shocker and Srivastava, 1979; Ratneshwar and Shocker, 1991; Srivastava, Alpert and Shocker, 1984; Srivastava, Leone and Shocker, 1981). Also, some researchers have looked at the effect of situational variables in an effort to illustrate the point that perceived inter-product relationships are not invariant but instead depend on the usage situation (Belk, 1975; Fennell, 1978; Lutz and Kakkar, 1975).

However, if such a usage based similarity approach were to be used, one would probably assume an underlying dimension of similarity, as depicted in figure 2 below.

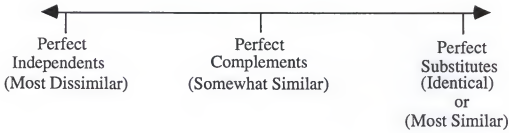


FIGURE 2
REPRESENTATION ASSUMING AN UNDERLYING DIMENSION OF SIMILARITY

Note, however, that the above depiction uses perfectly polar cases. One would find it hard to demarcate cut-off points to distinguish between imperfect substitutes and complements in such a dimensional representation. One would also not be able to discriminate between independents and complements. A more serious aspect of the problem, though, is that it is not at all obvious (and nor is it necessarily true) that goods perceived to be poor substitutes would be regarded as more similar than poor complements. Thus, one would expect Holbrook and Lehmann's (1981) criticism to apply in this case as well.

Holbrook and Lehmann (1981) have theorized that substitutes and complements are best understood on two different levels of analysis. Specifically, they view substitutes as goods (products/services/activities) that meet the same rather narrowly defined need, whereas complements are goods that fulfill a more broadly defined need. In terms of mental representation, then, this translates into a smaller "core" sphere of needs embedded in a larger sphere of broader needs, embedded in a still larger space defining all possible needs (see Figure 3 below)

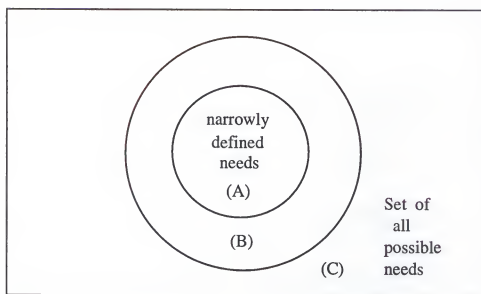


FIGURE 3
HOLBROOK AND LEHMANN'S (1981) PROPOSED REPRESENTATION

where entities falling within the confines of sphere (A) are substitutes, those within (B) but outside (A) are complements, and all other entities are independents for the situation under consideration.

It should be noted though, that this conceptualization of Holbrook and Lehmann can also be depicted by an underlying continuum similar to the one shown earlier. In this case, it would be a continuum of "breadth of needs that can be satisfied", as shown in Figure 4 below:

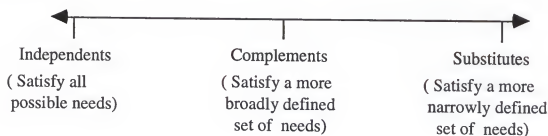


FIGURE 4
REPRESENTATION WITH A "BREADTH-OF-NEEDS-SATISFIED" DIMENSION

As can be seen above, the use of unidimensional representation gives rise to the same ordinal representation as the "similarity in use" continuum depicted in Figure 2. Also, the actual pairwise-distance numbers generated by subjects with instructions to use breadth of needs that can be satisfied are likely to closely follow numbers generated under a "similarity in use" criterion. Thus, such a conceptualization is likely to give rise to the same problems in distinguishing between substitutes and complements as seen earlier.¹

A Schema-Based Model of Mental Representation

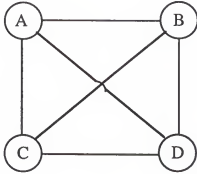
Holbrook and Lehmann (1981) stated that substitutes fulfill the same narrow needs and that complements fulfill a more broadly defined need. While they have chosen to represent this situation by their figure (Figure 3 above), that figure has its drawbacks, as explained above. However, the same thoughts on substitutes and complements fall neatly into place without any lessening of their intuitive statements on the relationship among substitutes, complements and needs, when looked at with a "schema" focus.

Thus, substitutes are items that go into the same slot for a schema (or usage situation, for example), and they do indeed fulfill a narrowly defined need. Complements, on the other hand, consist of different slots. Alternatively, two examples from the same schema, each from a different slot, are complements, and together, they do indeed fulfill a more broadly defined need. Independent entities are those that are not in the relevant schema, and thus include products that fulfill "all other possible needs".

Consider the case where a person has a goal in mind. To accomplish this goal, the person will need to acquire several objects and/or perform several activities; these will

¹However, it should be noted that Holbrook and Lehmann (1981) did not have to face this problem, since, although they hinted at such a conceptualization to distinguish between substitutes and complements, they did not use it - they used a correlational measure instead. Also, such a conceptualization *does* have its uses in understanding consumer choice. For example, M. D. Johnson (1984) has used a similar conceptualization to explain consumer choice strategies for comparing 'non-comparable' alternatives. Unfortunately, though, this approach would appear to have only limited power in helping one to discriminate between substitutes and complements.

therefore be complementary to one-another. Let there be four such complementary concepts: A, B, C, and D, which together form a schematic "whole" or goal. These complementary concepts may then be represented as shown in figure 5.



(Since the concepts form a schema, there will be spatio-temporal links between them. A graphical representation is shown at left. Note that it is a simplified version, since no exemplars - such as b_2 or c_3 are shown in the figure)

$$A = \{a_1, a_2, a_3 \dots\}$$

$$B = \{b_1, b_2, b_3 \dots\}$$

$$C = \{c_1, c_2, c_3 \dots\}$$

$$D = \{d_1, d_2, d_3 \dots\}$$

FIGURE 5
REPRESENTATION OF CONCEPTS AS A SCHEMA

Each concept may be achieved (or the "slot" for the concept be filled) by any one of several exemplars (cognitive substitutes, or c-substitutes). For instance, the schema depicted above might be instantiated by a consumer with the examples a_3 , b_2 , c_1 , and d_4 , as shown in Figure 6.

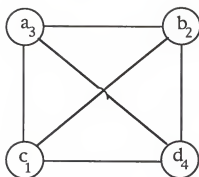


FIGURE 6
AN INSTANTIATION OF SCHEMA 1

Different schemas may be activated at other points in time. Thus, the proposed mental representation of complements, substitutes, and independents may be explained by the following figure:

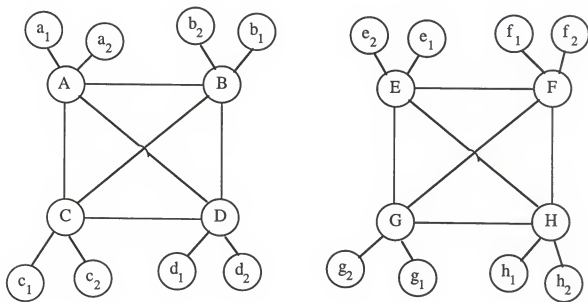


FIGURE 7
THE PROPOSED MENTAL REPRESENTATION OF COMPLEMENTS,
SUBSTITUTES AND INDEPENDENTS ACCORDING TO SCHEMA MEMBERSHIP

In the above example, a bundle formed by taking two items from any one slot would make up a bundle of cognitive (c-) substitutes. Thus, (a_1, a_2) , (b_1, b_2) , (c_1, c_2) , (d_1, d_2) would each be bundles of c-substitutes from the first schema, and (e_1, e_2) , (f_1, f_2) , (g_1, g_2) , (h_1, h_2) would each be bundles of c-substitutes from the second schema. Similarly, a bundle consisting of two items from different slots (but from the same schema) would constitute a bundle of c-complements, such as (a_1, b_2) , (a_2, b_2) , (a_1, b_1) , (a_1, c_2) , (c_2, d_2) , (d_1, b_1) from schema one, or (e_1, f_2) , (g_1, h_2) , (g_1, e_2) , (f_1, h_2) and so on from the second schema. Any bundle consisting of two items drawn from different schemas would be a bundle of c-independents (as long as the two items did not co-occur in some other schema), so that in the figure above, the bundles (a_1, e_2) , (a_2, e_2) , (a_1, e_1) , (a_1, f_2) , (g_2, c_2) , (h_1, b_1) are all bundles of c-independents.

Note also that the above network (figure 7) has been shown with "connections" between the exemplars and the concept that they are exemplars for, and not directly among the exemplars themselves. This is a better view of ad-hoc type c-complements than well-defined c-complements. One would expect well-defined c-complements to develop direct connections with one-another, but such a figure would be too complex (with all the so-called good c-complements linked to one-another directly), and so such connections have not been shown here (unlike in figure 6).

A description of the proposed methodology for studying all of the concepts developed herein is detailed in the next two chapters. The next chapter will describe a proposed new method of identifying c-substitutes and c-complements simultaneously. The perceived economic relationships among the products generated by this method will then be tested using two dependent measures, as described in detail in chapter 5: 1) a simple paper-and-pencil semantic measure asking subjects to rate the relationship (substitute/ independent /complement) between a pair of items in a given context, and 2) a more complex dependent measure based on Norman Anderson's (1982) concepts of Information Integration Theory

along with the definitions of substitutability and complementarity proposed by Fisher (1892).

The same methods will also be used to demonstrate that two goods may be substitutes in one context and complements in another (chapter 6). The demonstration will then be repeated across a much larger set of items, to further drive home the context-dependent nature of complementarity as well as substitution. This will be followed by a general discussion of the experimental results and the conclusion section (chapter 7).

CHAPTER 4 MEMORY-BASED NORMS OF SEMANTIC STRUCTURES

Introduction

Perceived similarity is a poor determinant of the nature of the economic relationship between products (substitutes/ complements/independents), as explained in the previous chapter. In contrast to the idea of an underlying dimension of similarity, the schema theory outlined in chapter 3 is a more specific and defensible representation of consumers' cognitive structures for both substitutes and complements. This chapter describes a memory-based method for identifying such schemas in order to predict the economic relationship between pairs of products. The method is then validated experimentally in the next chapter.

To increase generalizability, different types of schemas, with several examples for each type of schema were used. Subjects were asked to generate two types of schemas: (1) usage situations and (2) partonomies. Usage situations have been studied extensively in marketing and consumer research (cf. Ratneshwar and Shocker 1992; Day, Shocker and Srivastava 1979; Lutz and Kakkar 1976; Belk 1975), but only in reference to perceived substitutability - *not* complementarity. Partonomies, by contrast, have not been studied extensively in marketing.

Methodology

The method developed here is similar to the methodology of Barsalou and Hutchinson (1987). The generation procedure involved top of mind recall for each of three consecutive phases for each schema type, as explained below. Phase 1 was used to identify schemas that were readily accessible by the subjects. Phase 2 required subjects to list type

of products for each given schema, and in Phase 3, subjects were asked to list appropriate examples for each product type for every given schema. The subjects used for the procedure were undergraduate students, participating in exchange for course credit in a Principles of Marketing course at the University of Florida. (About 40 new subjects were used for each phase).

Phase 1

Subjects completed the task in groups of 10-15, and each group was asked to generate either usage situations or partonomies. They were asked to list as many schemas as possible on a blank sheet of paper. The task was explained briefly to the subjects with an example. For usage situation schemas, "Going Camping" was used as an example. Partonomies were explained as "ensembles" or a "whole" made up of product "parts". After the task was defined, subjects were asked to list as many usage situations or partonomies as possible in fifteen minutes. The resulting data was then analyzed using a frequency count, and the nine most frequently mentioned usage situations (or partonomies) were identified for usage in phase 2. The 18 schemas thus obtained (9 usage situations and 9 partonomies) are shown in Appendix A.

Phase 2

Two separate booklets were developed; one for usage situations and another for partonomies. The first page for a schema type consisted of the same example used initially in Phase 1 ("Going Camping" for usage situations, for instance), but, there was an additional column entitled "Product Types". The first page showed sample entries under product types for the schema, and explained the required task, giving instructions to subjects for filling the rest of the booklet (each page listed a new schema, and required subjects to list product categories used in/for the schema).

The next page repeated the schema used as the example, but this time required subjects to fill-in their own entries under "Product Types". This helped familiarize the subjects with the task, thus reducing the chance of a "learning curve" affecting the data. A sample of the booklets is provided in Appendix B.

The five types/parts mentioned most often were selected for usage in phase 3. The number was restricted to five because: (i) the data exhibited an "elbow" at or around five (i.e. the frequency of mention typically dropped markedly after the fifth product type), and (ii) selecting more product types (beyond five) would cause subject fatigue in the next phase.

Phase 3

Previously obtained and selected data were used to make two booklets, one for usage situations and another for partonomies. As in the previous phases, new subjects were used and subjects were presented with only one or the other booklet. Each page in the booklet presented the subjects with a schema and five product types or parts for that schema. Subjects were required to list two to three examples for each product type or part.

As before, the first page of the booklet illustrated the task with examples for each product type or part, and the schema was repeated on the next page and subjects were asked to fill-in their own examples before proceeding with the rest of the booklet. (Sample instructions are shown in Appendix C). The resulting data were frequency analyzed to obtain a complete description of each schema: the slots (product categories or "types" or "parts"), and the instantiations (specific examples for each slot) making up a particular schema (usage situation or product category).

Based on the schema theory developed earlier, the following hypotheses were formulated:

H1: Cognitive structure predicts (perceived) economic structure.

More specifically, this broad hypothesis consists of the following hypotheses:

H1a: Any two products from the same slot (i.e. product type or part) of a given schema are (economic) substitutes

H1b: Any two products drawn from different slots (i.e. product types or parts) of a given schema are (economic) complements

H1c: Any two products drawn from slots in different schemas are (economic) independents (as long as they do not also instantiate slots in some other schema)

A series of experiments used to test these hypotheses are detailed in the next two chapters.

CHAPTER 5 EXPERIMENT 1

Overview

A method of identifying schemas was described in the previous chapter. Schemas generated by this method allow for the identification of cognitive-substitutes, cognitive-complements and cognitive-independents (products that occupy the same slot in a schema are c-substitutes, products that occupy different slots in the same schema are c-complements, and products that do not co-appear in the same schema are c-independents). This chapter describes an experiment designed to investigate the hypothesis that cognitive structure predicts economic structure - that is, cognitive complements, substitutes and independents are also economic complements, substitutes, and independents respectively. The next section presents the development of stimuli and dependent measures used in the experiment, followed by the experimental procedure and a discussion of the analyses and results.

Stimuli

In keeping with the previous chapter, two sets of schemas were used as stimuli in the experiment: one of partonomical schemas and another of usage-situation schemas. The selection of stimuli followed an identical procedure in both cases; therefore, only the procedure used for the selection of usage situations is described in detail below.

For each of nine usage-situation schemas, the two most often cited "slots" (product types) were identified. For instance, consider the schema "Graduation Party". The two most often recalled slots for this schema were "Cake" and "Balloons". The most frequently recalled examples in each of these slots was "Chocolate Cake" and "Helium Balloons".

These examples became the "anchors" against which relationship comparisons were gauged, as explained below.

The next-most often recalled exemplars in the Cake and Balloon slots were Vanilla Cake and Latex Balloons, respectively. Thus, according to the method described in the previous chapter, Chocolate Cake and Vanilla Cake are c-substitutes in the "Graduation Party" schema. Similarly, Helium Balloons and Latex Balloons are c-substitutes. If the hypotheses are correct, then the respective pairs should also be economic substitutes (or e-substitutes)

By the same token, if the hypotheses developed so far are correct, Chocolate Cake and Latex Balloons should be complements in this schema, and so should Vanilla Cake and Helium Balloons. Figure 5-1 describes the development and selection of stimuli so far.

Anchor:	Chocolate Cake	Helium Balloons
Substitute:	Vanilla Cake	Latex Balloons
Complement:	Latex Balloons	Vanilla Cake

Figure 5-1
Schema: Graduation Party

That is, Chocolate Cake and Vanilla Cake would be expected to be e-substitutes, whereas Chocolate Cake and Latex Balloons would be expected to be e-complements. Similarly, Helium Balloons would be expected to be e-substitutes for Latex Balloons, but e-complements of Vanilla Cake in this schema.¹

According to the schema theory developed in this dissertation, any two products not occurring in the same schema should be independent. To make matters systematic (and experimentally testable), the independent products were chosen in the same manner for

¹For the sake of simplicity, "e-substitutes" will be referred to simply as "substitutes". The same convention will be maintained for e-complements and e-independents.

each anchor. Specifically, schemas were arbitrarily ordered and products from the "c-complement" or "c-substitute" row of the next schema were used to supply the c-independent product. This is illustrated in Figure 5-2 below, which shows how the products for the "c-independent" row for the Graduation Party schema were chosen from the "c-complement" row of the schema "Going Swimming at the Beach". (Thus, for the schema "Graduation Party", Chocolate Cake and Oakley's Sunglasses would be expected to be independent products).

Schema:	<u>Graduation Party</u>	<u>Going Swimming at the Beach</u>
Anchor:	Chocolate Cake	Beach Towel
Substitute:	Vanilla Cake	Bath Towel
Complement:	Latex Balloons	Oakley's Sunglasses
Independent:	Oakley's Sunglasses	

Figure 5-2
Generating the "Independent" item

The same procedure was used to lay out the stimuli for the remainder of the usage situation schemas. When choosing the order (i.e. adjacency) of schemas, care was taken to ensure that products from the "c-complement" or "c-independent" row of one schema were not recalled in any of the phases for the adjacent prior schema. This entire procedure was repeated for partonomies. The resulting stimuli are shown in Appendix D and E (Usage Situations and Partonomies, respectively).

A total of 18 schemas (9 usage situations and 9 partonomies) were selected using this procedure. Two "anchors" were selected from each schema, and each anchor was paired separately with three products (one at a time), thus giving rise to 6 pairs of products per schema. The experiment therefore required the correct assessment of the relationship of 108 pairs of products, drawn from 18 different schemas, making for a much stronger test

of the hypotheses than would be possible with just one set of products from a single schema.

Furthermore, two dependent variables were used in the experiment. One was a measure of super- or sub-additivity derived from subjects' utility ratings, and the other was semantic ratings of the relationship, as described below.

Dependent Measure 1 (Additivity of Utility)

This measure was developed by combining the notion of utility originally used by Fisher (1892) in his definitions of substitutes and complements, and the concepts of information integration theory developed by Norman Anderson (1981). As outlined in Chapter 2, Fisher (1892) defined the relationship between any two products x and y in terms of the additivity of their utility. Specifically, x and y were defined as being substitutes if their utility was sub-additive, complements if their utility was super additive, and independent if it was additive. That is, if the utility of both x and y together (U_{xy}) was less than the sum of their individual utilities ($U_x + U_y$), then x and y were defined as substitutes. If instead, the utility of the whole ($U_x + U_y$) was greater than the sum of the utility of the parts, then the items were defined as complements, and if the utility of the whole was equal to the sum of the individual utilities, then the items were defined as independent products. A specific measure of deviation from additivity will be described shortly. At a general level, however, this reasoning leads to the following hypotheses:

H2: The additivity of utility for c-complements/independents/substitutes will show the same pattern as expected for e-complements, e-substitutes, and e-independents

More specifically, this leads to the following sub-hypotheses:

H2a: Utility for c-substitutes will be more sub-additive than that for c-complements.

H2b: Utility for c-independents will be more sub-additive than that for c-complements and less sub-additive than that for c-substitutes.²

Dependent Measure 2 (Semantic Rating)

This measure was a simple task in which subjects rated the relationship between a given pair of products in a given schema on a scale of -4 to +4. That is, if subjects thought that the products were perfect substitutes, then they were required to assign a score of -4. Similarly, subjects were required to assign a score of +4 for perfect complements and a score of zero for products that were judged to be independent in the given schema. Products that were judged to be good substitutes (but not perfect substitutes) would be given a rating of -3 or even -2 if the degree of substitutability were lower, and a rating of -1 if the relationship was judged to be that of weak or poor substitutes. Similarly, the rating would be positive for complements; the greater the degree of complementarity, the higher the number. The specific instructions that were given are described in detail later. At a general level, however, the following hypotheses are natural:

H3a: Semantic ratings for products drawn from the same slot (c-substitutes) will be significantly less than zero

H3b: Semantic ratings for products drawn from different slots in the same schema (c-complements) and will be significantly greater than zero

H3c: Semantic ratings for products drawn from different slots in different schemas (c-independents) will not be significantly different from zero³

The development of hypotheses so far lead directly to the next hypothesis:

H4: The two measures (additivity of utility and semantic rating) will converge. That is, the pattern of results obtained will be similar for both measure.

²Note that for the purposes of this study, more sub-additivity of utility is equivalent to less super-additivity for these hypotheses. Similarly, less sub-additivity is equivalent to more super-additive of utility.

³Hypotheses 2 and 3 have been decomposed differently to clarify subsequent discussions of the results.

In other words, the ordering of means for c-substitutes, c-independents and c-complements will be the same for both measures.

Experimental Procedure

All subjects participating in these experiments were undergraduate students enrolled in the Principles of Marketing course at the University of Florida who received extra credit for their participation. Subjects were run in cohorts of 5-20, and were presented with two booklets each (one for each dependent measure). To make the instructions easier to follow and to prevent confusion, each cohort was presented with booklets of only one type of schema (either usage situations or partonomies). One hundred and forty-four subjects filled out the booklets with usage situations while one hundred and fifty-six did so with partonomies.

The experimental design for each schema type was identical. Each experiment had a 9 (schema) X 3 (Version) X 3 (Relationship) X 2 (Anchor), orthogonal fractional factorial design, where Schema and Relationship were within-subject factors and Version and Anchor were between-subjects factors. Thus, nine different schemas were used for each schema type. The factor "Version" indicated the type of cognitive relationship for which subjects had to provide ratings in their first judgment. For example, the first c-relationship presented to one group of subjects was that of c-substitutes, to another group, c-complements, and to the yet another, c-independents. The order in which stimuli were presented to the subjects was kept constant (e.g. c-substitutes followed by c-complements followed by c-independents, followed by c-substitutes followed by c-complements, and so on).

Subjects were asked to not begin reading the booklets until after the instructions for the utility rating tasks were given. They were then asked to read only the first page of the first booklet, which contained a repetition of the instructions along with a sample of the required task. Subjects were asked to read and fill in the booklet one page at a time, without

turning back. They were also asked to wait for further instructions before beginning with the second booklet.

A sample instruction page from the first booklet is shown in Appendix F. Subjects were told that the value of the given schema containing an assortment of 8 items was fixed at a "1000 points". These "extra" items (8 for each schema) were used in addition to the items of interest (say, x and y). This was done to make the perception of a given schema roughly comparable across subjects. That is, it was done with the idea of invoking a part-category cueing effect (cf. Alba and Chattopadhyay 1985) which would prevent subjects from thinking of additional, unmentioned items for a given schema. Thus, they would be responding to the relevant items (x and y) in a relatively uniform context across subjects.

Three such sets of assortments were laid out on each page; the first containing 8 items, the next containing 9 items (all of the previous items plus x), and the last containing 10 items (all of the previous items plus y). The value of the schema when it consisted of the original 8 items was fixed at 1000 points. After going over the first column, subjects were asked to rate the schema when it contained an additional item (x), given that the schema was worth 1000 points without it. Subjects were instructed that the rating had to be greater than or equal to the rating of the previous column. They were then required to move to the third (and last) column on the page, and again assign a point rating to the schema. As before, subjects were required to assign a rating greater than or equal to the rating assigned to the schema for the previous column. That is, the utility contribution of items x and y was always constrained to be non-negative.

Each subject filled out the practice page and then proceeded to fill out the columns for each of the nine schemas (one to a page). To control for the effects of order of introduction of the key items x and y , each subject had to fill out nine additional pages

which were identical to the previous nine except that the order of introduction of x and y was reversed.⁴

Measuring Deviations from Additivity

The ratio used as the dependent variable (T_{xy}) was calculated as follows:

$$T_{xy} = \{R_X + R_Y - 2000\} / \{(R_{xy} + R_{yx} - 2000) / 2\}$$

where the utility of a schema with 8 items (that is, without x or y) was always fixed at a 1000 points, and

R_X was the subject-generated point rating for the schema with one additional item (x), and

R_Y was the subject-generated point rating for the schema with one additional item (y), and

R_{xy} was the subject-generated point rating for the schema with two additional items (x & y)

R_{yx} was the subject-generated point rating for the schema with two additional items (y & x)

Thus, $\{R_X - 1000\}$ could be considered the utility contribution of x as perceived by the

subject. Similarly, $\{R_Y - 1000\}$ could be considered the perceived utility contribution of y,

and $\{R_{xy} - 1000\}$ the perceived utility contribution of both x and y, where x was the ninth and y the tenth item presented to subjects.

If the ratio thus calculated were greater than one, this would imply sub-additivity of utility for x and y, and if it were less than 1, it would imply super-additivity, and if equal to 1 it would imply additivity of utility for x and y.

Semantic Rating

After all the subjects in a cohort had finished with the utility ratings task in the first booklet, the experimenter explained the task required in the second booklet. No mention had been made of the relationship among items (that is substitutes/ complements/

⁴ For instance, say page 2 of the booklet showed column 1 with the assortment of 8 items with the value of the schema fixed at 1000 points, and column 2 with the same 8 plus item x, and column 3 with the same 8 plus x plus y. Then page 11 of that booklet would show the same schema with the same 8 items presented in column 1, but with the same 8 plus y in column 2, and the 8 items plus y plus x in column 3.

independents) up to this point. After a brief verbal explanation, subjects were allowed to read this second booklet where the first page provided instructions and a practice example (see Appendix G for an example of the first page from the second booklet). For each schema, each subject saw only one pair of products, and had to judge the relationship by circling the appropriate number from -4 to +4. After filling out the first page, subjects were asked to continue judging the relationships as required in the rest of the booklet. As before, the booklets displayed one schema per page, and subjects were asked to not turn back after finishing with a page, but to keep going forward. The order of presentation of stimuli in the second booklet was identical to that in the first booklet; thus, any context effects due to stimulus order were held constant. Each subject was asked to turn in his or her booklets after finishing, whereupon a brief exit interview was conducted by the experimenter. This allowed the experimenter to ascertain subjects' judgments about the relationships between products in their own words.

The data were analyzed using Analysis of Variance with the aid of the SAS program. The analyses of the results of the experiment are discussed in the next section, beginning with those for the first dependent measure (utility rating) for usage situations, and then for partonomies. This is followed by the analyses and discussion of results for the second dependent measure for usage situations and then partonomies. Finally, the chapter is concluded with a general discussion of the results of the experiment.

Analyses for Utility Ratings

The value of the Additivity Index was calculated as described earlier. These data were analyzed separately for each of the two types of schemas (usage situations and partonomies), as described below.⁵ The Schema*Version interaction contained the main

⁵The analyses described for each of the two individual schema types (usage situations and partonomies) were also performed on a combined data set which contained data from both schema types, using 'schema type' as an additional, between-subjects factor with two levels. The pattern of the results was identical to that found in the separate analyses for

effect of Relationship, therefore, the sum of squares of variance for Relationship had to be subtracted from the sum of squares for the interaction to get the corrected (or residual) figures for the Schema*Version interaction.⁶ If the hypotheses derived so far are true, then most of the explainable variance assignable to the interaction must be due to the main effect of relationship between the products.

Usage Situations

The results of the analyses of variance for the utility ratings dependent measure are shown in table 5-1, 5-2 and 5-3⁷. As Table 5-1 indicates, the main effects of Version and Anchor (a replicate) were not significant ($p>0.68$, and $p>0.37$, respectively). The interaction term, Version*Anchor was not significant either ($p>0.23$).

The effect of Relationship was significant ($p<0.0001$). As predicted, Relationship accounted for the bulk of the variance assignable to Schema*Version interaction (85.5%). Relationship was also the single largest factor accounting for the overall variance, accounting for 73.29% of the overall explainable within-subjects variance. In other words, whether the manipulated pair of products was picked from the same slot in the same schema or different slots within the same schema or from different schemas altogether, accounted for 73.29% of explainable within-subjects variance in the data.

In addition, the Schema factor (schema from which the manipulated pair was picked) was also significant at the $p<0.0001$ level. The interaction effect of Schema*Anchor was not significant ($p>0.05$) whereas the residual effect of Relationship*Version was significant ($p<0.0001$), although the main effect for Version

usage situations and paronomies. Furthermore, none of the interactions with 'schema type' were significant, hence this analysis is not described in detail herein.

⁶This is consistent with the treatment suggested by Winer, Brown and Michels (1991, page 706-711) for fractional factorial Latin Square designs.

⁷For the sake of simplicity, Schema and Anchor have been treated as fixed effects. Therefore, these results do not generalize statistically beyond the particular words used in the experiment (cf. Keppel 1991, Appendix C). This does not, however, affect the key effect of Relationship, which appeared to account for the bulk of the variance in each case.

was not significant ($p > 0.6822$). The interaction effect of Relationship*Anchor was not significant ($p > 0.26$), while the residual effect of the three-way interaction Schema*Version*Anchor was significant ($p < 0.0001$). However, as no hypotheses were made regarding these effects, and they did not account for much of the variance in the data, they are not discussed in further detail.

There were two instances of each of the three possible relationships between products for each of the nine schemas in the design. Table 5-2 shows the mean derived utility rating for each pair of products drawn from each usage situation schema by the type of cognitive relationship.

TABLE 5-1
ANALYSIS OF VARIANCE FOR DERIVED UTILITY MEASURE - USAGE
SITUATION SCHEMAS

SOURCE	df	Type III SS	F	p > F
<u>Between-Subject Effects</u>				
Version	2	0.1363	0.38	0.6822
Anchor	1	0.1391	0.78	0.3780
Version*Anchor	2	0.5275	1.48	0.2307
Error	121	21.4946		
<u>Within-Subject Effects</u>				
Schema (1)	8	3.3057	4.65	0.0001
Relationship (2)	2	39.0918	151.5	0.0001
Schema*Version (res.) (3)	14	6.635	6.28	0.0001
Schema*Anchor (1)	8	1.3813	1.94	0.0537
Relationship*Anchor (2)	2	0.3403	1.32	0.2695
Schema*Version*Anchor (res.) (3)	14	3.1039	2.94	0.0001
Error (Schema) (1)	968	86.0729		
Error (Relationship) (2)	242	31.2946		
Error (residual) (3)	726	54.7783		

Note: Figures in parentheses denote correspondence between error terms and effects.

For example, Error (Schema) (1) is the relevant error term for Schema (1) as well as Schema*Anchor (1).

TABLE 5-2
MEAN DERIVED UTILITY RATIOS FOR USAGE SITUATION SCHEMAS - (BY
RELATIONSHIP)

SCHEMA (From which Anchor was picked):	c-substitutes	c-complements	c-independents
Graduation Party	1.4192	1.0306	0.9085
Going Swimming (at the Beach)	1.3288	1.0313	0.9252
Typical Thanksgiving Dinner	1.5902	1.0820	1.0679
Going on a Picnic	1.4724	1.1264	0.9264
Playing Tennis	1.7153	1.0320	0.9831
Pre-Football Game Party	1.4321	1.0652	1.2232
Going Fishing	1.3141	1.1109	1.0463
Turning 21 Party	1.2338	1.1316	1.0207
Going Camping	1.5314	1.1175	1.0908
MEAN	1.4486	1.0808	1.0253

Note: A Score > 1 implies sub-additivity,

< 1 implies super-additivity

and $= 1$ implies additivity of utility.

As Table 5-2 indicates, the pattern of the data is consistent across schemas. Further analyses (Table 5-3) also revealed that the mean scores for c-substitutes, c-complements and c-independents were always significantly different from one another across all nine schemas ($p < 0.0001$ in 8 cases and $P < 0.0005$ for the schema: "Turning 21" Party). These results therefore show that the additivity of utility of selected pairs of products differs depending on whether the pairs were selected from the same slot or different slot within the same schema, or, alternatively, from different schemas.

It was expected that the utility would be sub-additive for c-substitutes, super-additive for the c-complements and additive for the c-independents. For this to be the case, derived utility ratio scores would have to be greater than one for c-substitutes, less than one for c-complements and equal to one for c-independents. However, as Table 5-2 indicates, expectations were upheld only in the case of the c-substitutes and c-independents. That is, c-substitutes (pairs picked from the same slot in a schema) did indeed exhibit sub-additive

utility, and c-substitutes were always more sub-additive than c-complements or c-independents. Thus, the results support hypothesis 2a.

TABLE 5-3
F-STATISTIC VALUES FOR RELATIONSHIP - FOR EACH USAGE SITUATION
SCHEMA

SCHEMA (From which Anchor was picked):	RELATIONSHIP	
	F-Value	p > F
Graduation Party	23.05	0.0001
Going Swimming (at the Beach)	15.65	0.0001
Typical Thanksgiving Dinner	38.21	0.0001
Going on a Picnic	22.48	0.0001
Playing Tennis	63.44	0.0001
Pre-Football Game Party	11.89	0.0001
Going Fishing	9.90	0.0001
"Turning 21" Party	8.17	0.0005
Going Camping	38.81	0.0001

While c-independents (pairs picked from slot in different schemas) showed nearly additive utility and so were always less sub-additive than c-substitutes, c-complements (pairs picked from different slots in the same schema) did not display super-additive utility. In fact, on average, c-complements displayed more sub-additive utility than c-independents, so that only partial support was obtained for hypothesis 2b. I will return to this anomaly in the General Discussion section of this chapter.

A more detailed description of the utility ratio scores is provided in Table 5-4, showing the mean scores for each of the 54 pairs of products used in this study. This table shows that the utility of the c-substitutes was always sub-additive, while c-complements actually displayed super-additive utility in 5 of the 18 cases, and c-independents exhibited a range from sub to super-additive utilities, with a mean score close to additivity.

Table 5-4
MEAN DERIVED UTILITY RATIOS FOR EACH PRODUCT PAIR FOR USAGE
SITUATION SCHEMAS

SCHEMA (& Corresponding Anchor):	Cognitive Substitute	Cognitive Complement	Cognitive Independent
Graduation Party Anchor1: Chocolate Cake	Vanilla Cake 1.38448	Latex Balloons 0.97635	Oakley's Sunglasses 0.90677
Going Swimming (at the Beach) Anchor1: Beach Towel	Bath Towel 1.14424	Oakley's Sunglasses 0.93826	Homemade Stuffing 0.94306
Typical Thanksgiving Dinner Anchor1: Butterball Turkey	Louis Rich Turkey 1.63746	Homemade Stuffing 1.04413	Plastic Basket 1.06069
Going on a Picnic Anchor1: Wicker Basket	Plastic Basket 1.42841	Woolen Blanket 1.16835	Prince Ten. Racquet 1.07842
Playing Tennis Anchor1: Wilson Tennis Ball	Penn Tenn. Ball 1.78192	Prince Ten. Racquet 0.98817	Lay's Pot. Chips 0.95582
Pre-Football Game Party Anchor1: Budweiser Beer	Bud Light Beer 1.32740	Lay's Pot. Chips 1.17382	Plastic Tackle Box 1.22125
Going Fishing Anchor1: Cane Fishing Pole	Fishing Rod & Reel 1.29781	Plastic Tackle Box 1.16126	Clothes (as a gift) 1.08005
"Turning 21" Party Anchor1: Chocolate Cake	Ice Cream Cake 1.37824	Clothes (as a gift) 1.03647	Nylon Sleeping Bag 1.05725
Going Camping Anchor1: Metal Flashlight	Plastic Flashlight 1.58884	Nylon Sleeping Bag 1.11470	Latex Balloons 1.07189

Table 5-4 (continued)

SCHEMA (& Corresponding Anchor):	Cognitive Substitute	Cognitive Complement	Cognitive Independent
Graduation Party Anchor2: Helium Balloons	Latex Balloons 1.45400	Vanilla Cake 1.08738	Bath Towel 0.91036
Going Swimming(@ the Beach) Anchor2: Ray Ban Sunglasses	Oakley's Sunglasses 1.53023	Bath Towel 1.12434	Louis Rich Turkey 0.90461
Typical Thanksgiving Dinner Anchor2: Stove Top Stuffing	Homemade Stuffing 1.54299	Louis Rich Turkey 1.11993	Plastic Basket 1.07537
Going on a Picnic Anchor2: Cotton Blanket	Woolen Blanket 1.51641	Plastic Basket 1.08619	Penn Tennis Ball 0.85118
Playing Tennis Anchor2: Wilson Ten. Racquet	Prince Ten. Racquet 1.64866	Penn Tennis Ball 1.07574	Bud Light Beer 1.10103
Pre-Football Game Party Anchor2: Ruffles Pot. Chips	Lay's Pot. Chips 1.52803	Bud Light Beer 0.95651	Fishing Rod & Reel 1.22501
Going Fishing Anchor2: Metal Tackle Box	Plastic Tackle Box 1.33046	Fishing Rod & Reel 1.06055	Ice Cream Cake 1.01392
"Turning 21" Party Anchor2: Money (as a gift)	Clothes (as a gift) 1.09538	Ice Cream Cake 0.98585	Plastic Flashlight 1.06055
Going Camping Anchor2: Cotton Sleeping Bag	Nylon Sleeping Bag 1.47400	Plastic Flashlight 1.12033	Vanilla Cake 1.10973

Partonomical Schemas

The results of the analyses of variance for the derived utility ratings measure used with partonomical schemas are shown in Tables 5-5, 5-6 and 5-7. The pattern of results was almost identical to those seen earlier with usage situations. However, the main effect of Version was significant ($p < 0.0008$) in the case of partonomies, though not in the case of usage situations ($p > 0.6822$). The interaction effect of Version*Anchor was not significant in either case.

As predicted, the main effect of Relationship was significant ($p < 0.0001$). Also, as predicted, the factor accounting for the largest amount of explainable variance (76.22%) was "relationship". In other words, whether the manipulated pair of products was picked from the same slot in the same schema or different slots within the same schema or from different schemas altogether, accounted for 76.22% of explainable within-subjects variance in the data (and 89.83% of the variance assignable to the - uncorrected - Schema*Version interaction).

The interaction effect of Relationship*Version was significant ($p < 0.0001$) in the case of Partonomies, as in the case of Usage Situations. Similarly, the main effect of Schema and the interaction effect of Schema*Version was also significant ($p < 0.0001$) for Partonomies (as well as Usage Situations).

There were two instances of each of the three possible cognitive relationships between products for each of the nine Partonomy schemas used in the design. Table 5-6 shows the mean derived utility ratios for each pair of products drawn from each Partonomy by the type of cognitive relationship.

Table 5-6 shows a pattern that is consistent across most of the partonomies, and is remarkably similar to the pattern seen with Usage Situations (compare with Table 5-2). For instance, all the c-substitutes showed sub-additive utility, and the mean ratio score was sub-additive for c-complements as well as independents, just as with the Usage Situation

schemas. More detailed analyses (shown in Table 5-7) revealed that the ratios differed significantly across the three predicted relationship-groups for each Partonomy ($p < 0.0001$), thus providing support for the notion that the additivity of utility of selected pairs differs depending on whether the pairs are selected from the same slot or different slot from within the same schema, or, alternatively, from different schemas.

TABLE 5-5
ANALYSIS OF VARIANCE FOR DERIVED UTILITY MEASURE - PARTONOMY SCHEMAS

SOURCE	df	Type III SS	F	p > F
<u>Between-Subject Effects</u>				
Version	2	3.2294	7.51	0.0008
Anchor	1	0.121	0.56	0.4542
Version*Anchor	2	0.235	0.55	0.5800
Error	148	31.8106		
<u>Within-Subject Effects</u>				
Schema (1)	8	5.898	7.97	0.0001
Relationship (2)	2	66.1591	225.89	0.0001
Schema*Version (residual) (3)	14	7.4847	7.18	0.0001
Schema*Anchor (1)	8	0.6428	0.87	0.4994
Relationship*Anchor (2)	2	0.3452	1.18	0.3079
Schema*Version*Anchor (res.) (3)	14	7.4847	7.18	0.0050
Error (Schema) (1)	1184	109.4992		
Error (Relationship) (2)	296	43.3466		
Error (Residual) (3)	888	66.1527		

Note: Figures in parentheses denote correspondence between error terms and effects.

For example, Error (Schema) (1) is the relevant error term for Schema (1) as well as Schema*Anchor (1).

It was expected that the utility would be sub-additive for c-substitutes, additive for c-independents and super-additive for c-complements. However, as Table 5-6 indicates, expectations were upheld only in the case of c-substitutes. In fact, the general pattern of the

results shown in Table 5-8 is almost identical to those obtained in the case of Usage Situations (see Table 5-2). As with Usage Situations, the c-substitutes were always more sub-additive than the c-complements or c-independents, thus supporting hypothesis 2a. C-independents displayed a near-additive mean score, and thus were always less sub-additive than c-substitutes. However, c-complements were mostly sub-additive, and were more sub-additive than independents on the average. Thus, only partial support was obtained for hypothesis 2b. Again, this anomaly will be discussed in more detail in the General Discussion of the chapter.

TABLE 5-6
MEAN DERIVED UTILITY RATIOS FOR PARTONOMY SCHEMAS - (BY
RELATIONSHIP)

SCHEMA (From which Anchor was picked):	c-substitutes	c-complements	c-independents
Office Furniture	1.5174	1.1021	0.9187
Fall Wardrobe (for Women)	1.2350	1.0313	0.9930
IBM-PC Compatible Equipment	1.6556	1.0645	1.0401
Professional Attire (for Men)	1.4408	1.0518	1.0561
Dinner at a Fancy Restaurant	1.2435	1.0939	0.9984
First-Aid Kit	1.7305	1.1490	1.0086
School Supplies	1.6054	1.1551	1.0993
Entertainment System	1.5399	0.9537	1.1045
Women's Make-up Kit	1.6494	1.1236	0.9622
MEAN	1.5131	1.0858	1.0201

Note: A Score > 1 implies sub-additivity,
 < 1 implies super-additivity
 and $= 1$ implies additivity of utility.

A more detailed description of the utility ratio scores is provided in Table 5-8, showing the mean score for each of the 54 pairs of products used in this study. The table shows that the utility of the c-substitutes was always sub-additive, while c-complements actually displayed super-additive utility in only two of the eighteen cases (both were for c-complements from the "Entertainment System" Partonomy), and as seen with Usage Situations, the utility scores ranged from sub-additive to super-additive for c-independents.

TABLE 5-7
F -STATISTIC VALUES FOR RELATIONSHIP (DERIVED UTILITY RATIOS) - FOR
EACH PARTONOMY

SCHEMA (From which Anchor was picked):	RELATIONSHIP	
	F-STATISTIC	p > F
Office Furniture	15.42	0.0001
Fall Wardrobe (for Women)	10.72	0.0001
IBM-PC Compatible Equipment	73.32	0.0001
Professional Attire (for Men)	29.36	0.0001
Dinner at a Fancy Restaurant	10.51	0.0001
First-Aid Kit	141.12	0.0001
School Supplies	54.14	0.0001
Entertainment System	43.54	0.0001
Women's Make-up Kit	89.10	0.0001

TABLE 5-8
MEAN DERIVED UTILITY RATIOS FOR EACH PRODUCT PAIR - PARTONOMIES

SCHEMA (& Corresponding Anchor):	Cognitive Substitute	Cognitive Complement	Cognitive Independent
Office Furniture Anchor1: Metal Desk	Wood Desk 1.50743	Wood Filing Cabinet 1.13374	9-West Shoes 0.81221
Fall Wardrobe (for Women) Anchor1: V-neck Sweater	Cardigan 1.19491	9-West Shoes 1.07738	Mouse - Packard Bell 0.92457
IBM-PC Compatible Equipment Anchor1: Keyboard - IBM	Keyboard - Packard Bell 1.67228	Mouse - Packard Bell 1.03444	Seiko Watch 1.05343
Professional Attire (for Men) Anchor1: Rolex Watch	Seiko Watch 1.45738	Striped Tie 1.08819	Chocolate Mousse 1.04981
Dinner at a Fancy Restaurant Anchor1: Red Wine	White Wine 1.31975	Chocolate Mousse 1.06272	Curad - Band-Aid * 1.01140
First-Aid Kit Anchor1: J&J Gauze	Eckerd - Gauze 1.69815	Curad - Band-Aid * 1.17382	Mechanical Pencils 1.00659
School Supplies Anchor1: #2 Pencils	Mechanical Pencils 1.49207	Bic Pens 1.19769	Panasonic VCR 1.09471
Entertainment System Anchor1: Sony TV	RCA TV 1.57586	Panasonic VCR 0.92177	Maybelline Blush 1.07649
Women's Make-up Kit Anchor1: Maybelline Lipstick	Revlon Lipstick 1.50784	Maybelline Blush 1.16065	Wood Filing Cabinet 0.92975

TABLE 5-8 (continued)

SCHEMA (& Corresponding Anchor):	Cognitive Substitute	Cognitive Complement	Cognitive Independent
Office Furniture Anchor2: Metal Filing Cabinet	Wood Filing Cabinet 1.52744	Wood Desk 1.02395	Cardigan 1.02517
Fall Wardrobe (for Women) Anchor2: Bass Shoes	9-West Shoes 1.27504	Cardigan 1.1268	Keyboard - Packard Bell 1.06148
IBM-PC Compatible Equipment Anchor2: Mouse - IBM	Mouse - Packard Bell 1.6389	Keyboard - Packard Bell 1.09458	Striped Tie 1.02684
Professional Attire (for Men) Anchor2: Polo Tie	Striped Tie 1.42422	Seiko Watch 1.01545	White Wine 1.06241
Dinner at a Fancy Restaurant Anchor2: Cheesecake	Chocolate Mousse 1.16415	White Wine 1.12507	Eckerd Gauze 0.98545
First-Aid Kit Anchor2: J&J Band-Aid	Curad Band-Aid * 1.7629	Eckerd Gauze 1.10052	Bic Pens 1.01058
School Supplies Anchor2: Papermint Pens	Bic Pens 1.71865	Mechanical Pencils 1.11258	RCA TV 1.1039
Entertainment System Anchor2: Magnavox VCR	Panasonic VCR 1.50255	RCA TV 0.98563	Revlon Lipstick 1.1325
Women's Make-up Kit Anchor2: Covergirl Blush	Maybelline Blush 1.79094	Revlon Lipstick 1.08656	Wood Desk 0.99469

* The item "Curad Band-Aid" was used in this study based on its elicitation in earlier phases of data collection, even though Band-Aid is a Johnson & Johnson product, and Curad is not.

Analyses for Semantic Ratings

After a cohort of subjects finished filling the first booklet (utility ratings), they were given instructions for filling the second booklet. This next task consisted of judging the semantic relationship between pairs of products in a given schematic context (usage situation or partonomy), by assigning a score from -4 (perfect substitutes) to +4 (perfect complements), as explained earlier. The order of presentation of stimuli in the second booklet was identical to that seen by subjects in the earlier booklet. The results for Usage Situation schemas are described below, followed by the results for Partonomies. The chapter is concluded by a general description of the results for both variables and both types of schemas.

Usage Situations

The results of analysis of variance for the semantic ratings measure for Usage Situations are shown in Table 5-9, 5-10, 5-11, and 5-12 below. As predicted, Relationship accounted for the bulk of the variance assignable to the Schema*Version interaction (91.84%). Relationship was also the factor accounting for the single largest amount of explainable within-subjects variance in the data (88.41%). The main effect of Schema was significant ($p < 0.0001$) too, as with the first dependent variable. The main effects of Version and Anchor were also significant ($p < 0.0001$ and $p < 0.0471$, respectively), unlike the earlier results. In addition, the Schema*Anchor interaction and the residual effects of the interactions of Schema*Version and Schema*Version*Anchor were all significant ($p < 0.0001$ in each case). The main effect of Relationship was significant and the interaction effects of Relationship*Version was also significant ($p < 0.0001$ in both cases). The other effects were not significant at the .05 level. Since the overwhelming amount of explainable within-subjects variance (88.41%) was accounted for by the variable

of interest (Relationship), and since the other effects did not affect the hypotheses, they have not been discussed in more detail.

Table 5-10 shows the mean semantic ratings for product pairs drawn from each Usage Situation schema by type of cognitive relationship. The results clearly show that the subjects' judgments were exactly as predicted (that is, the mean scores for c-substitutes were indeed negative, those for c-substitutes - positive, and those for c-independents - closely dispersed around zero). Furthermore, as Table 5-11 indicates, the mean scores for each schema (by cognitive relationship) were always significant ($p < 0.0001$), thus providing strong support for H3, H3a, H3b and H3c. That is, the semantic judgment of the relationship between pairs of products in a given schema seemed to depend systematically on whether the products were drawn from the same slot or different slots within the same schema, or from different schemas, and the pattern of the data was identical to predictions. Thus, these results also provide support for hypothesis H1 - cognitive structures do indeed predict economic structures.

Table 5-12 shows the mean semantic ratings for each product pair for every usage situation. As shown, every pair picked from the same slot in the same schema was given a mean negative rating (that is, was judged to be a pair of substitutes). Similarly, every pair picked from different slots within the same schema was given a mean positive rating (that is, was judged to be a pair of complements). Finally, every pair of products picked from different schemas was given a mean rating close to zero (that is, was judged to be a pair of independents). These results therefore provide strong, unequivocal support for hypotheses H1 and H3.

Partonomical Schemas

The results of the analyses of variance for the semantic ratings measure are shown in Tables 5-13, 5-14, 5-15 and 5-16.

TABLE 5-9
ANALYSIS OF VARIANCE FOR SEMANTIC RATING MEASURE - USAGE
SITUATIONS

SOURCE	df	Type III SS	F	p > F
<u>Between-Subject Effects</u>				
Version	2	99.3164	19.19	0.0001
Anchor	1	10.3827	4.01	0.0471
Version*Anchor	2	6.6952	2.59	0.0788
Error	138	357.0463		
<u>Within-Subject Effects</u>				
Schema (1)	8	56.4552	3.42	0.0015
Relationship (2)	2	6051.5478	1068.02	0.0001
Schema*Version (residual) (3)	14	537.733	21.28	0.0001
Schema*Anchor (1)	8	92.3812	5.6	0.0001
Relationship*Anchor (2)	2	0.7423	0.13	0.8431
Schema*Version*Anchor (res.) (3)	14	128.6034	5.09	0.0001
Error (Schema) (1)	1104	2276.537		
Error (Relationship) (2)	276	781.9259		
Error (Residual) (3)	828	1494.6111		

Note: Figures in parentheses denote correspondence between error terms and effects.

For example, Error (Schema) (1) is the relevant error term for Schema (1) as well as Schema*Anchor (1).

TABLE 5-10
MEAN SEMANTIC RATINGS FOR USAGE SITUATIONS - BY RELATIONSHIP

SCHEMA (From which Anchor was picked):	For Pairs Picked From:		
	Same slot	Different slot	Different schemas
	cognitive substitutes	cognitive complements	cognitive independents
Graduation Party	-2.1047	1.2917	0.0833
Going Swimming (at the Beach)	-2.4167	1.4167	0.0208
Typical Thanksgiving Dinner	-3.7083	3.3542	0.1667
Going on a Picnic	-3.6875	2.6875	0.2292
Playing Tennis	-3.3958	3.6458	0.3333
Pre-Football Game Party	-3.2917	3.0417	0.1458
Going Fishing	-2.0417	2.8542	0.1250
"Turning 21" Party	-1.3542	0.7708	0.0417
Going Camping	-3.5833	2.8750	-0.0833
MEAN	-2.8427	2.4375	0.1181

TABLE 5-11
F-STATISTIC VALUES FOR RELATIONSHIP - FOR EACH USAGE SITUATION
(SEMANTIC RATING)

SCHEMA (From which Anchor was picked):	RELATIONSHIP	
	F-Value	p > F
Graduation Party	44.88	0.0001
Going Swimming (at the Beach)	56.38	0.0001
Typical Thanksgiving Dinner	788.83	0.0001
Going on a Picnic	368.39	0.0001
Playing Tennis	309.25	0.0001
Pre-Football Game Party	311.21	0.0001
Going Fishing	104.58	0.0001
"Turning 21" Party	16.34	0.0001
Going Camping	534.28	0.0001

TABLE 5-12
MEAN SEMANTIC RATING FOR EACH PRODUCT PAIR - USAGE SITUATIONS

SCHEMA (& Corresponding Anchor):	Cognitive Substitute	Cognitive Complement	Cognitive Independent
Graduation Party Anchor1: Chocolate Cake	Vanilla Cake -1.75000	Latex Balloons 1.66667	Oakley's Sunglasses 0.08333
Going Swimming (at the Beach) Anchor1: Beach Towel	Bath Towel -1.70833	Oakley's Sunglasses 1.41667	Homemade Stuffing 0.04167
Typical Thanksgiving Dinner Anchor1: Butterball Turkey	Louis Rich Turkey -3.70833	Homemade Stuffing 3.29167	Plastic Basket 0.25000
Going on a Picnic Anchor1: Wicker Basket	Plastic Basket -3.75000	Woolen Blanket 2.83333	Prince Ten. Racquet 0.20833
Playing Tennis Anchor1: Wilson Tennis Ball	Penn Tenn. Ball -3.54167	Prince Ten. Racquet 3.91667	Lay's Pot. Chips 0.70833
Pre-Football Game Party Anchor1: Budweiser Beer	Bud Light Beer -3.70833	Lay's Pot. Chips 3.20833	Plastic Tackle Box 0.08333
Going Fishing Anchor1: Cane Fishing Pole	Fishing Rod & Reel -0.58333	Plastic Tackle Box 3.08333	Clothes (as a gift) 0.29167
"Turning 21" Party Anchor1: Chocolate Cake	Ice Cream Cake -2.62500	Clothes (as a gift) 0.66667	Nylon Sleeping Bag 0.16667
Going Camping Anchor1: Metal Flashlight	Plastic Flashlight -3.50000	Nylon Sleeping Bag 2.95833	Latex Balloons -0.16667

TABLE 5-12 (continued)

SCHEMA (& Corresponding Anchor):	Cognitive Substitute	Cognitive Complement	Cognitive Independent
Graduation Party Anchor2: Helium Balloons	Latex Balloons -2.45833	Vanilla Cake 0.91667	Bath Towel 0.08333
Going Swimming(@ the Beach) Anchor2: Ray Ban Sunglasses	Oakley's Sunglasses -3.12500	Bath Towel 1.41667	Louis Rich Turkey 0.00000
Typical Thanksgiving Dinner Anchor2: Stove Top Stuffing	Homemade Stuffing -3.70833	Louis Rich Turkey 3.41667	Plastic Basket 0.08333
Going on a Picnic Anchor2: Cotton Blanket	Woolen Blanket -3.62500	Plastic Basket 2.54167	Penn Tennis Ball 0.25000
Playing Tennis Anchor2: Wilson Ten. Racquet	Prince Ten. Racquet -3.25000	Penn Tennis Ball 3.37500	Bud Light Beer -0.04167
Pre-Football Game Party Anchor2: Ruffles Pot. Chips	Lay's Pot. Chips -2.87500	Bud Light Beer 2.87500	Fishing Rod & Reel 0.20833
Going Fishing Anchor2: Metal Tackle Box	Plastic Tackle Box -3.50000	Fishing Rod & Reel 2.62500	Ice Cream Cake -0.04167
"Turning 21" Party Anchor2: Money (as a gift)	Clothes (as a gift) -0.08333	Ice Cream Cake 0.87500	Plastic Flashlight -0.08333
Going Camping Anchor2: Cotton Sleeping Bag	Nylon Sleeping Bag -3.66670	Plastic Flashlight 2.79167	Vanilla Cake 0.00000

Unlike the results for Usage Situations, the main effect of Anchor was not significant for Partonomies ($p > 0.6055$). The interaction effect of Version*Anchor was also non-significant ($p > 0.7245$). All other sources of variance showed the same pattern for Partonomies as they had for Usage Situations. For instance, the factor accounting for the largest amount of explainable within-subject variance (90.98%) was Relationship, and it was, of course, significant ($p < 0.0001$). As predicted, Relationship accounted for the bulk of the variance assignable to the Schema*Version (95.16%). The interaction effect of Relationship*Anchor was not significant ($p > 0.42$). The main effects of Schema, and of Version, as well as the residual interaction effects of Schema*Version and Schema*Version*Anchor were all significant ($p < 0.0001$, $p < 0.0001$, and $p < 0.025$, respectively). However, since the bulk of the explainable variance was accounted for by the variable of interest (relationship), and since the hypotheses are not affected by the other effects, they are not discussed here in further detail.

The mean semantic ratings for each partonomy (by cognitive relationship) are shown in Table 5-14. The results show the same pattern as the results for usage situations. For instance, every pair picked from the same slot in the same schema was given a mean negative rating (that is, was judged to be a pair of substitutes). Similarly, every pair picked from different slots within the same schema was given a mean positive rating (that is, was judged to be a pair of complements). Finally, every pair of products picked from different schemas was given a mean rating close to zero (that is, was judged to be a pair of independents).

The relationships differed significantly as predicted, and did so for each and every partonomical schema (Table 5-15), providing support for the notion that ratings differ depending on the cognitive structure, similar to the results obtained with usage situation schemas. The mean semantic scores for each of the 54 product pairs used in this study are provided in Table 5-16 below.

TABLE 5-13
ANALYSIS OF VARIANCE FOR SEMANTIC RATING MEASURE - PARTONOMIES

SOURCE	df	Type III SS	F	p > F
<u>Between-Subject Effects</u>				
Version	2	130.6709	25.57	0.0001
Anchor	1	0.6845	0.27	0.6055
Version*Anchor	2	1.651	0.32	0.7245
Error	150	383.3205		
<u>Within-Subject Effects</u>				
Schema (1)	8	196.2308	11.76	0.0001
Relationship (2)	2	6695.3974	1207.74	0.0001
Schema*Version (residual) (3)	14	340.3291	13.09	0.0001
Schema*Anchor (1)	8	9.5014	0.57	0.7615
Relationship*Anchor (2)	2	4.463	0.81	0.4293
Schema*Version*Anchor (res.) (3)	14	60.4117	2.32	0.0250
Error (Schema) (1)	1200	2502.3333		
Error (Relationship) (2)	300	831.5641		
Error (residual) (3)	900	1670.7692		

Note: Figures in parentheses denote correspondence between error terms and effects.

For example, Error (Schema) (1) is the relevant error term for Schema (1) as well as Schema*Anchor (1).

TABLE 5-14
MEAN SEMANTIC RATINGS FOR PARTONOMIES - BY RELATIONSHIP

SCHEMA (From which Anchor was picked):	For Pairs Picked From:		
	Same slot	Different slot	Different schemas
	cognitive substitutes	cognitive complements	cognitive independents
Office Furniture	-2.6923	1.5962	0.1539
Fall Wardrobe (for Women)	-2.9615	2.3077	0.0192
IBM-PC Compatible Equipment	-3.3077	1.0385	-0.0962
Professional Attire (for Men)	-2.7115	2.1539	0.1346
Dinner at a Fancy Restaurant	-3.0577	2.4423	0.0385
First-Aid Kit	-3.7115	1.1923	0.0577
School Supplies	-3.4039	0.1346	0.1154
Entertainment System	-3.8846	3.8269	0.0000
Women's Make-up Kit	-3.6346	3.5385	0.2692
MEAN	-3.2628	2.0256	0.0769

TABLE 5-15
F-STATISTIC RATING FOR RELATIONSHIP - FOR EACH PARTONOMY
(SEMANTIC RATING)

SCHEMA (From which Anchor was picked):	RELATIONSHIP	
	F-STATISTIC	p > F
Office Furniture	105.86	0.0001
Fall Wardrobe (for Women)	182.14	0.0001
IBM-PC Compatible Equipment	67.43	0.0001
Professional Attire (for Men)	190.82	0.0001
Dinner at a Fancy Restaurant	240.98	0.0001
First-Aid Kit	105.87	0.0001
School Supplies	62.58	0.0001
Entertainment System	5136.41	0.0001
Women's Make-up Kit	760.98	0.0001

TABLE 5-16
MEAN SEMANTIC RATINGS FOR EACH PRODUCT PAIR - PARTONOMIES

SCHEMA (& Corresponding Anchor):	Cognitive Substitute	Cognitive Complement	Cognitive Independent
Office Furniture Anchor1: Metal Desk	Wood Desk -2.80769	Wood Fil. Cabinet 1.50000	9-West Shoes 0.23077
Fall Wardrobe (for Women) Anchor1: V-neck Sweater	Cardigan -3.03846	9-West Shoes 2.19231	Mouse - Packard Bell 0.00000
IBM-PC Compatible Equipment Anchor1: Keyboard - IBM	Keyboard - Packard Bell -3.07692	Mouse - Packard Bell 1.26923	Seiko Watch -0.15385
Professional Attire (for Men) Anchor1: Rolex Watch	Seiko Watch -2.88462	Striped Tie 2.00000	Chocolate Mousse 0.03846
Dinner at a Fancy Restaurant Anchor1: Red Wine	White Wine -3.30769	Chocolate Mousse 2.38462	Curad - Band-Aid * 0.00000
First-Aid Kit Anchor1: J&J Gauze	Eckerd - Gauze -3.84615	Curad - Band-Aid * 1.50000	Mechanical Pencils 0.11538
School Supplies Anchor1: #2 Pencils	Mechanical Pencils -2.88462	Bic Pens -0.61538	Panasonic VCR 0.26923
Entertainment System Anchor1: Sony TV	RCA TV -3.92308	Panasonic VCR 3.84615	Maybelline Blush -0.03846
Women's Make-up Kit Anchor1: Maybelline Lipstick	Revlon Lipstick -3.26923	Maybelline Blush 3.26923	Wood Fil. Cabinet 0.19231

TABLE 5-16 (Continued)

SCHEMA (& Corresponding Anchor):	Cognitive Substitute	Cognitive Complement	Cognitive Independent
Office Furniture Anchor2: Metal Filing Cabinet	Wood Fil. Cabinet -2.57692	Wood Desk 1.69231	Cardigan 0.07692
Fall Wardrobe (for Women) Anchor2: Bass Shoes	9-West Shoes -2.88462	Cardigan 2.42308	Keyboard - Packard Bell 0.03846
IBM-PC Compatible Equipment Anchor2: Mouse - IBM	Mouse - Packard Bell -3.53846	Keyboard - Packard Bell 0.80769	Striped Tie -0.03846
Professional Attire (for Men) Anchor2: Polo Tie	Striped Tie -2.53846	Seiko Watch 2.30769	White Wine 0.23077
Dinner at a Fancy Restaurant Anchor2: Cheesecake	Chocolate Mousse -2.80769	White Wine 2.5	Eckerd Gauze 0.07692
First-Aid Kit Anchor2: J&J Band-Aid	Curad Band-Aid * -3.57692	Eckerd Gauze 0.88462	Bic Pens 0
School Supplies Anchor2: Papermint Pens	Bic Pens -3.92308	Mechanical Pencils 0.88462	RCA TV -0.03846
Entertainment System Anchor2: Magnavox VCR	Panasonic VCR -3.84615	RCA TV 3.80769	Revlon Lipstick 0.03846
Women's Make-up Kit Anchor2: Covergirl Blush	Maybelline Blush -4	Revlon Lipstick 3.80769	Wood Desk 0.34615

* The item "Curad Band-Aid" was used in this study based on its elicitation in earlier phases of data collection, even though Band-Aid is a Johnson & Johnson product, and Curad is not.

As shown, the relationship was perceived by subjects in a manner consistent with the proposed mental representation model in each of the 18 pairs of c-substitutes, in 17 of

the 18 pairs of c-complements, and in each of the 18 pairs of c-independents. These results are very similar to those seen for usage situations, and they therefore strengthen the already strong, unequivocal support for hypotheses H1 and H3.

General Discussion

The results of the experiment(s) show strong support for hypotheses H1 and H3. For instance, the utility ratings as well as the semantic ratings of the product pairs differed systematically and significantly depending on the manner in which the pairs were constructed, thus providing some support for the proposed mental representation model.

The results for the first dependent variable (derived utility ratios), show some support for H 1, since c-substitutes always exhibited sub-additive utility for both, Usage Situations as well as Partonomies. However, c-complements did *not* show super-additivity utility, in the bulk of the cases for either schema type. In fact, c-complements showed super-additive utility in only 5 of 18 cases involving Usage Situation schemas, and only 2 of 18 cases involving Partonomical schemas. Thus, the results did not fully support H 2b. Partial support for H 2b was obtained, since the c-independents did indeed show near-additive utility in most of the cases, and c-independents were always less sub-additive than c-substitutes.

However, the c-complement-pairs did not show super-additive utility. What is more, the utility for c-complements was in most cases, more sub-additive than that for the c-independents - a violation of the expected order of additivities. The reason for not obtaining full support for H 2b, then, has to be either (i) the pairs in question were not complements (i.e. the proposed mental representation model may be wrong), or (ii) the pairs were complements, but failed to show the expected ordering of additivity of utility

If the utility ratings given by the subjects were influenced by a concave psychophysical scaling function (as is often the case), this might explain the lack of super-additivity for the bulk of the c-complements. Recall that the utility ratings were actually for

the schema, not the pairs themselves, and that the critical items (x and y) were the ninth and tenth items introduced for each schema. A "diminishing returns" phenomenon, therefore, is not at all unexpected, and this might explain the general sub-additivity (regardless of the relationship).

However, this would not explain why the utility for c-complements was more sub-additive than that for the c-independents. This objection, though, can be overcome by examining the pattern of the actual scores assigned by subjects. Specifically, a comparison of R_y - the utility assignable to the critical "y" item (i.e. not the anchor) for each pair across the three different possible relationships is instructive. As Table 5-17 shows, the increase in utility ratings assigned to the schemas was equal to zero (that is, R_y was equal to 1000) far more often for c-independents than for c-substitutes or c-complements.

The process of assigning utility scores in the case of independent products was therefore qualitatively different from that for substitutes or complements⁸. The failure to obtain complete support for H 2b can thus be attributed to this process difference, combined with a floor effect caused by the diminishing marginal utility contribution of the ninth and tenth items in each schema. Table 5-17 and the resulting graph in Figure 5-1 show the values of R_y and T_{xy} , as well as the corresponding frequencies of c-complements, c-substitutes and c-independents. Figure 5-1 clearly shows that the pattern of T_{xy} scores was actually *in accordance* with predictions as R_y increased. The pattern differed markedly only at the point where R_y was = 1000 (that is, when there was zero additional contribution to the schema by item y). Since this was the case with the bulk of the c-independents (67%), this was enough to change the pattern of the results in the entire data set.

⁸Recall that the basic principle used in deriving the dependent measure was to try to approximate the utility contribution for product 'x' alone, 'y' alone, and that for the pair (x+y) together, and to calculate the ratio $((x)+(y))/(x+y)$. If the critical item 'y' is irrelevant to the schema (as in the case of independents), it is likely to add zero utility to the schema. The ratio thus reduces to $((x)+(0))/(x+0) = (x)/(x) = 1$.

TABLE 5-19
DATA FOR T_{xy} AND CORRESPONDING FREQUENCIES OF C-COMPLEMENTS,
C-SUBSTITUTES, AND C-INDEPENDENTS AT VARIOUS SCREENING LEVELS
OF R_y

R_y	T_{xy} (C)	T_{xy} (I)	T_{xy} (S)	Freq-C	Freq-I	Freq-S	Cum-C	Cum-I	Cum-S
1000	0.907	1.008	0.997	23	607	30	23	607	30
1001-1010	1.056	1.002	1.233	17	91	15	40	698	45
1011-1020	1.071	0.963	1.330	8	10	8	48	708	53
1021-1030	1.218	1.099	1.506	14	15	10	62	723	63
1031-1040		1.023	1.221	0	1	1	62	724	64
1041-1050	1.021	1.030	1.360	56	48	52	118	772	116
1051-1060	1.414		1.577	1	0	2	119	772	118
1061-1070	0.986		1.733	2	0	1	121	772	119
1071-1080	1.208	1.067	1.629	2	1	7	123	773	126
1081-1090	1.354	1.289		2	1	0	125	774	126
1091-1100	1.035	1.128	1.391	183	57	194	308	831	320
1101-1110			1.512	0	0	1	308	831	321
1111-1120			1.512	0	0	1	308	831	322
1121-1130	0.979		1.513	33	0	34	341	831	356
1131-1140	1.257		1.060	1	0	1	342	831	357
1141-1150	1.099	1.271	1.337	36	5	31	378	836	388
1151-1160	1.100			1	0	0	379	836	388
1161-1170				0	0	0	379	836	388
1171-1180			1.875	0	0	1	379	836	389
1181-1190			1.208	0	0	1	379	836	390
1191-1200	1.091	1.218	1.535	174	20	178	553	856	568
1201-1210				0	0	0	553	856	568
1211-1220				0	0	0	553	856	568
1201+	1.140	1.468	1.603	341	24	321	894	880	889

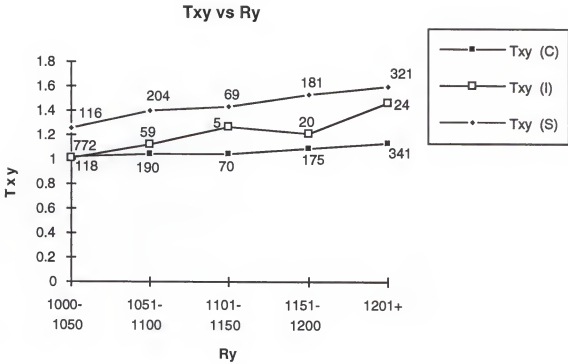


FIGURE 5-1
GRAPH OF Txy vs. Ry, WITH FREQUENCIES OF C-SUBSTITUTES, C-
INDEPENDENTS AND C-COMPLEMENTS AT EACH POINT⁹

⁹Note from the graph that the correspondence between cognitive structure and economic structure is supported completely for all of the data points for c-complements and c-substitutes, and for all of the data points for c-independents beyond Ry=1050.

The results of the analysis of the second dependent variable are unequivocal in their support for hypotheses H2 and H3. This second variable involved a direct judgment task, wherein subjects were required to rate the relationship between pairs of products in a given schema, and the ratings were almost always in line with the predictions. Specifically, c-substitutes were always perceived to be e-substitutes by subjects, so also, c-independents were perceived to be e-independents in every case. Similarly, c-complements were perceived to be e-complements in every possible case of Usage Situations, and in 17 of 18 cases of Partonomies. Furthermore, the exit interview conducted by the experimenter showed that the subjects did indeed perceive the products drawn from the same slot within a schema to be e-substitutes, the products drawn from different schemas to be e-independents, and the products drawn from different slots within the same schema to be e-complements. The results therefore support the hypothesis of congruence between the two dependent measures (H4).

In fact, the exit interviews revealed the reason for the "low" scores for complements in both types of schemas. For instance, Bic Pens and #2 pencils were predicted to be complements in the schema "school supplies", but the mean ratings categorized them as independents. The exit interviews revealed that many subjects felt the pair could be either substitutes or complements, and therefore decided to give the pair a rating midway between substitutes and complements. Given the scale used, this pushed the rating close to zero (i.e. independence).

This phenomenon was also seen in other cases where c-complements received low scores (such as Johnson & Johnson Band-Aid and Eckerd Gauze in the First-Aid Kit schema, Papermint Pens and Mechanical Pencils in the School Supplies schema). Thus, the interviews clearly showed that this was due to multiple schematic representations of the same pair of products, and not due to a flaw in the proposed mental representation model. This idea of simultaneous activation of several schemas is supported by Jean Mandler (1984).

Thus, there is strong support for hypotheses H1, H2, H3 and H4. These results provide strong support for the contention that cognitive structure predicts economic structure. Thus, the organization of substitutes and complements is schematic in nature, where products occupying the same slot within a schema are substitutes, and those occupying different slots within the same schema are complements.

Given this form of mental representation, it is natural to expect the relationship between the same two products (substitutes/ complements) to vary depending on the nature of the schema evoked. This idea is investigated in the next chapter, which demonstrates that products which are substitutes in one context can be viewed as complements in another context.

CHAPTER 6

THE REVERSIBLE NATURE OF SUBSTITUTIVE AND COMPLEMENTARY RELATIONSHIPS

Overview

The results of the first experiment strongly support the proposed schema-based model for substitutes, complements and independents. If this model is, in fact, an accurate description of consumers' mental representation, then it follows that the same two items judged to be substitutes in one schema may also be judged to be complements in another schema (depending on the relative positions of the items in the schemas). In other words, it follows from the proposed model that the nature of the relationship between products (substitutes/complements) may vary by context - for the same individual.

The two experiments described sequentially in this chapter demonstrate the schema-dependent nature of the relationship between items. Both experiments used within-subjects designs. Experiment two consisted of five pairs of products in two contexts each. Experiment three was similar to the former, but used seventeen pairs of products, thus serving to more extensively test the generalizability of the results.

Experiment Two

Stimulus Materials

Students from an undergraduate class at the University of Florida were asked to provide examples of products that were substitutes in one context but complements in another. The example provided to the students to help explain the task was that of Oranges and Apples, which are potential substitutes in the context of having a fruit after dinner, but

are potential complements in the context of making a fruit salad. The responses were subjected to a frequency analysis to determine pairs that were cited most often across subjects. The five most-often cited examples were used in the experiment (see Appendix H for a list of the stimuli).

Experimental Design and Procedure

The experiment used a 5 (product pairs) X 2 (contexts), within-subjects design. Sixty-nine subjects participated in cohorts of ten to fifteen in this experiment. Two dependent measures were used: the first based on a judgment of utility, and the next based on a semantic rating (with the same scale as in experiment one). As before, the data were collected in two separate booklets; one for each measure. In addition, subjects were always required to make utility judgments before giving semantic ratings.¹

The stimuli were presented in a random order. Subjects were asked not to begin reading the second booklet before the entire cohort had finished the first booklet and instructions had been read for the second measure. The same order of presentation was used in both booklets, and an exit interview was conducted with each subject after she/he finished both tasks. The experiment was thus designed to test the following hypotheses:

¹Note that the first dependent measure in this experiment was somewhat different from the one used in the previous study, because the stimulus-development procedure was not the same as before. Specifically, in this study, subjects were presented with a schema, and informed that the schema was worth a 1000 points when it included a particular product (say 'x'). In other words, the schema (x+z) was worth 1000 points- where z denotes utility of the schema without x. Subjects were later asked to rate the same schema when another product ('y') was also present in the schema (that is, they were asked to give a utility rating for x+z+y). (see Appendix 6-3). To control for the order of presentation of the products, data was collected again for the same products and schema, but with the order reversed. That is, subjects were asked to rate (y+z+x), given that the value of (y+z) was fixed at 1000 points. The dependent measure was calculated by this ratio: $\{((x+z)/(x+z+y)) + ((y+z)/(y+z+x))\}$, where the value of the numerator was always fixed at 1000, thus giving $\{((1000)/(x+z+y)) + ((1000)/(y+z+x))\}$.

Note also that the method of calculation gives rise to the expectation of a positive number greater than one for both, substitutes and complements - although one would expect a greater number for substitutes than for complements, since the schema would be worth more if a complement was added to the existing products, as compared to the situation when a substitute was added to the existing products in the schema.

H5: The perceived relationship between the same pair of products is context-dependent. Thus, the same products that are perceived to be substitutes in one context may be perceived to be complements in another.

This basic hypothesis will be tested by using the two independent measures described above, giving rise to the following hypotheses:

H6: The derived utility ratio for a given pair of products will be significantly higher when the products are considered in a context within which they are perceived to be substitutes than when the products are perceived to be complements.

H7: The semantic rating for the same pair of products will differ significantly depending on the context within which they are considered.

The results of the experiment are presented and discussed in the next section, beginning with the analysis of the data collected for the first variable (utility ratios), followed by the analysis for the second variable (semantic ratios). This is followed by a description of experiment three, a partial replication using only the second dependent variable and seventeen pairs of products.

Results for First Dependent Variable (Derived Utility Ratio):

The results of the analysis of variance for the first dependent variable show a significant main effect of "status" as well as "pair" (Table 6-1). That is, the data are explained by the systematic variation of the context which changed the perceived relationship between the products (the effect referred to as "status"). The data are also explained by the differences arising from the fact that five different pairs of products were used (the effect referred to as "pair"). In addition, the interaction effect of pair*status was also significant. However, the largest amount of explainable variance in the data (82.17%) was accounted for by the variable of interest (status), making it the most important source of variation in this study.

TABLE 6-1
ANALYSIS OF VARIANCE FOR DERIVED UTILITY RATIO MEASURE -
EXPERIMENT TWO

SOURCE	df	Type III SS	F	p > F
<u>Within-Subject Effects</u>				
Status	1	21.638288	116.77	0.0001
Error (Status)	66‡	12.229922		
Pair	4	3.668485	20.38	0.0001
Error (Pair)	264	11.882361		
Status*Pair	4	1.028435	6.85	0.0001
Error (Status*Pair)	264	9.913769		

‡ Although data were collected for 69 subjects, two subjects failed to fill out the entire booklet. Observations with missing values could not be used in the analysis. Thus, only 67 observations were included in this analysis.

TABLE 6-2
MEAN DERIVED-UTILITY RATIOS FOR EACH PAIR (BY CONTEXT)

PAIR	SUBSTITUTE CONTEXT & MEAN RATIO	COMPLEMENT CONTEXT & MEAN RATIO
GRANOLA & PEANUTS	A SNACK	TRAIL MIX
	1.6181	1.2168
ICE-CREAM & COOKIES	AFTER DINNER SNACK	ICE-CREAM SANDWICH
	1.5068	1.0369
SHRIMP & CLAMS	A DINNER ENTREE	SEA-FOOD GUMBO
	1.5362	1.1463
TAPES & CDs	LISTENING TO MUSIC	TAPING FROM CDs
	1.3639	1.0754
CARROTS & CELERY	VEG. DISH WITH DINNER	PART OF A SALAD
	1.5376	1.2716

However, a closer look at the data and the results shows that the interaction was significant merely because of the differences in the magnitude of the ratios across "pair" and "status" (Table 6-2). That is, the ratios were *always* in conformity with expectations (higher for pairs in the substitute context than for the same pairs - or indeed, any pairs- in the complement context). In addition, repeated-measures analysis showed the "status" effect to be significant ($F=116.77$, $p<0.0001$), whereas neither the contrasts for "pair" nor the contrasts for the pair*status interaction were always significant at the 0.05 level. Thus, the results support hypotheses H5 and H6.

Results for Second Dependent Variable (Semantic Rating):

The results of the analysis of variance for the second dependent variable were similar to those obtained with the first dependent variable. As shown in Table 6-3, the main effect of "status", the main effect of "pair" and the pair*status interaction were all significant. As before, the largest amount of explainable variance (94.58%) was accounted for by the variable of interest (status).

TABLE 6-3
ANALYSIS OF VARIANCE FOR SEMANTIC RATING MEASURE - EXPERIMENT
TWO

SOURCE	df	Type III SS	F	p > F
<u>Within-Subject Effects</u>				
Status	1	4322.5058	503.83	0.0001
Error (Status)	68	583.3942		
Pair	4	41.6609	2.69	0.0414
Error (Pair)	272	1054.1391		
Status*Pair	4	206.1536	13.53	0.0001
Error (Status*Pair)	272	1036.4464		

The fact that the interaction term was statistically significant was unimportant for the same reasons as before, as demonstrated by the actual mean semantic ratings shown in Table 6-4. That is, the interaction appears to be significant as the result of the difference in the magnitude of the ratings but not due to a difference in the type of the rating. Furthermore, a repeated-measures analysis of the data showed that the contrast for status was significant ($F=503.83$, $p<0.0001$), whereas the contrasts were not significant at the .05 level for "pair" in three of the cases, and for the pair*status interaction in two of the cases.

TABLE 6-4
MEAN SEMANTIC RATINGS FOR EACH PAIR (BY CONTEXT)

PAIR	SUBSTITUTE CONTEXT & MEAN RATING	COMPLEMENT CONTEXT & MEAN RATING
GRANOLA & PEANUTS	A SNACK -2.1449	TRAIL MIX 3.7536
ICE-CREAM & COOKIES	AFTER DINNER SNACK -2.3043	ICE-CREAM SANDWICH 3.0870
SHRIMP & CLAMS	A DINNER ENTREE -1.3623	SEA-FOOD GUMBO 1.4928
TAPES & CDs	LISTENING TO MUSIC -2.2319	TAPING FROM CDs 3.1014
CARROTS & CELERY	VEG. DISH WITH DINNER -2.5362	PART OF A SALAD 3.0145

Discussion of Experiment Two:

The results of the experiment show strong support for hypotheses H5, H6 and H7. In other words, there is strong experimental support for the idea that the same two products

that are viewed as substitutes in one schema may be viewed as complements in another schema. This finding, in turn, provides further support for the basic schema theory of mental representation proposed by this dissertation.

Interestingly, the stimuli obtained from subjects in the pre-test (and used in experiment two) share a number of characteristics among themselves, and with the "seed" stimuli provided as examples by the experimenter. For instance, most of the stimuli are food items, and the schemas in which they are embedded as complements all appear to be partonomy schemas. This is most probably due to the fact that the seed stimuli had the same characteristics (apples & oranges in a fruit salad).

A replication of experiment two was therefore carried out with usage-situation schemas, to see whether the same pattern of results would be obtained. The number of schemas used was increased (seventeen schemas were used, as opposed to only five in the study reported above). Since the first dependent variable did not seem to be as useful as the second one, and since the experiment required each subject to make many more judgments than experiment two, only the second (semantic rating) measure was employed in experiment three, discussed in detail below.

Experiment Three

Stimulus Materials

Experiment three was intended to be a partial replication of experiment two. In addition, it was carried out to gain further understanding of underlying "norms", if any. Therefore, the stimuli used in the experiment were collected from just five subjects (to see if previous results could nevertheless be replicated). In addition, the stimuli included both usage situation and partonomy schemas, unlike experiment two above, which had been restricted to partonomies. The basic method of stimulus selection was identical to the method used earlier, except for the fact that the data was collected from far fewer subjects

and using a different "seed" or example provided by the experimenter. (A list of the stimuli obtained is shown in Appendix I). As long as more than one (out of the five) subjects mentioned a particular example, it was used, with one exception.² The pretest gave rise to seventeen pairs of products in two contexts each, such that the relationship between the products in each pair was predicted to be substitutive in one context and complementary in another.

Experimental Design and Procedure

The experiment used a 17 (product pairs) X 2 (contexts), within-subjects design. Thirty-nine subjects participated in cohorts of ten to twelve in this experiment. Since each subject had to make a minimum of thirty four judgments, only the second dependent (semantic rating) measure was used in this experiment.

The stimuli were presented at random to prevent the order of presentation from having any effects. Subjects were asked not to begin reading the booklet before the task was explained by the experimenter. An exit interview was conducted with each subject after she/he finished the task. The experiment was thus designed to test hypotheses 12 and 14 (described earlier). In addition, it was felt that "normative" and "base-line" information might be obtained from this exploratory study.

Results and Discussion for Experiment Three

The data were analyzed using repeated measures analysis of variance. Table 6-5 shows the sums of squares of variance for the different main effects and interactions, and Table 6-6 displays the mean semantic ratings for each pair, as before.

²The exception consisted of the pair 'TV & Radio', in the contexts 'Away Football Game' and 'A Form of Entertainment'.

TABLE 6-5
ANALYSIS OF VARIANCE FOR SEMANTIC RATINGS - EXPERIMENT THREE

SOURCE	df	Type III SS	F	p > F
<u>Within-Subject Effects</u>				
Status	1	8682.0882	605.42	0.0001
Error (Status)	38	544.9412		
Pair	16	1782.6350	36.42	0.0001
Error (Pair)	608	1860.1885		
Status*Pair	16	665.3861	13.13	0.0001
Error (Status*Pair)	608	1925.0845		

TABLE 6-6
MEAN SEMANTIC RATING FOR EACH PAIR (BY CONTEXT) - EXPERIMENT
THREE

PAIR	SUBSTITUTE CONTEXT & MEAN RATING	COMPLEMENT CONTEXT & MEAN RATING
BEER & COLA	CHOOSING A BEVERAGE -3.5641	THROWING A PARTY 2.641
PEANUT-BUTTER & JELLY	SOMETHING TO PUT ON TOAST -1.5897	MAKING A SANDWICH 3.3846
PIE & ICE-CREAM	CHOOSING A DESSERT -0.8205	EATING PIE-A-LA-MODE 3.6923
TV & RADIO	A FORM OF ENTERTAINMENT -3.2820	AN AWAY FOOTBALL GAME -2.2564*
TV & STEREO	A FORM OF ENTERTAINMENT -2.8718	WATCHING TV IN STEREO 3.1026
JACKET & SWEATER	CLOTHING FOR A COOL DAY -3.1026	CLOTHING FOR A "FREEZING COLD" DAY 2.6411
COFFEE & MILK	CHOOSING A BEVERAGE -1.7949	COFFEE WITH CREAM 3.2051
BANANAS & ICE- CREAM	AN AFTER-DINNER SNACK -1.6923	BANANA SPLIT 3.9487
KETCHUP & MAYONNAISE	A CONDIMENT FOR SANDWICHES -1.8205	MAKING 1000 ISLAND DRESSING 3.6410
PEN & PENCIL	A WRITING INSTRUMENT -3.3846	CONTRASTING ON A DRAWN GRAPH 0.8462
MOUNTAIN-BIKE & CAR	A MEANS OF TRANSPORT -3.0000	GOING ON A NATURE TRAIL THROUGH THE MOUNTAINS (FAR AWAY) 2.641
ICE-CREAM & MILK	A SOURCE OF CALCIUM -2.6410	MAKING A MILKSHAKE 3.7179

TABLE 6-6 (continued)

PAIR	SUBSTITUTE CONTEXT & MEAN RATING	COMPLEMENT CONTEXT & MEAN RATING
BEER & WHISKEY	CHOOSING AN ALCOHOLIC DRINK -3.0769	MAKING A "BOILERMAKER" 3.4615
RUM & VODKA	AN ALCOHOLIC DRINK -2.9231	A LONG-ISLAND ICED- TEA 3.3333
COKE & RUM	A BEVERAGE BEFORE DINNER 0.8205*	A MIXED DRINK 3.7692
HAM & TURKEY	CHOOSING A SANDWICH MEAT -3.2051	FIXING A CLUB SANDWICH 3.3846
ORANGE JUICE & VODKA	CHOOSING A BEVERAGE 0.0513*	A "SCREWDRIVER" 3.9487

* Ratings that differed from predictions

The results were in keeping with expectations in all but three of the thirty-four cases. The most notable exception was the pair "TV & Radio", for which the relationship was rated to be substitutive in the context "Away Football Game" by experimental subjects, although the pretest had predicted the relationship to be complementary. It should be noted, however, that this particular case was based on the rating of a single subject in the pretest. In addition, the majority of the experimental subjects stated in the exit-interview that they felt they would use "either the TV or the Radio" to follow an "Away Football Game". Similarly, several subjects stated that they had given ratings close to zero (i.e. independence) for the other two exceptions, because the relationships "could go either way, and could either be substitutive or complementary".

What is perhaps more surprising is that the experimental subjects agreed on the relationships between items with the pretest subjects in thirty-one out of thirty-four cases,

despite the fact that the stimuli were developed on the basis of responses by just five (or fewer) pre-test subjects. Furthermore, the largest amount of explainable variance (78%) was again accounted for by the variable of interest (status). Thus, the procedure appears to be quite robust, and it seems that fairly similar schemas are evoked by subjects that are similar to one another.

Further analyses showed that the mean ratings for pairs in the "substitute" context were always significantly below zero, and were always significantly above zero in the "complement" context.³ Thus, the results support hypotheses H5 and H7.

Conclusion

These two experiments, taken together, provide strong support for the idea that substitutability and complementarity are dictated by the schema (or context) within which such relationship judgments are made. This is to be expected if the basic schema-model put forth in this dissertation is true and in that sense, these findings provide further support for the proposed mental representation. The next chapter summarizes the findings of this dissertation.

³Apart from the exceptions noted above. Even in the case of these exceptions, though, the general direction of the results was maintained. That is, the pairs were always judged to be 'more negative' in the substitute context than in the complement context, or 'more positive' in the complement context than in the substitute context.

CHAPTER 7 SUMMARY AND CONCLUSION

The existing paradigms for the study of complements are primarily based on definitions relying on cross-price or cross-demand elasticity. However, cross-elasticity measures are purely definitional; they do not explain the presence of complementarity. This dissertation is a first step toward the development of a theory of complementarity. It proposes a model of the mental representations of products, that reveals substitute, complement and independent relationships in a straightforward way.

The schema-based model developed here defined any two products from the same slot of a given schema to be cognitive-substitutes, whereas products drawn from different slots within the same schema were defined to be cognitive-complements. Similarly, products drawn from slots in different slots were defined to be cognitive-independents (as long as the products did not also instantiate slots in some other shared schema). The first set of experiments provided strong support for the notion that cognitive structure predicts economic structure (that is, cognitive-complements are also perceived economic-complements, c-substitutes are also e-substitutes, and c-independents are also e-independents).

Such a theory (of schema-driven substitutability and complementarity) also means that substitute/complement judgments are context-dependent, so that the same two products that are judged to be substitutes in one context may be judged to be complements in another context. The second set of studies (detailed in chapter 6) demonstrated that products judged to be substitutes in one context may be judged to be complements in another, and vice versa.

The schema-elicitation technique used to develop stimuli and test the proposed model of cognitive structure was described in chapter 4. While this technique was essential for generating the necessary stimuli, it may have practical uses in marketing research as well. For instance, the method (or a suitable variant) may be a useful way of identifying substitutes and complements, in contrast to the cross-price elasticity approach that is usually considered the standard (cf. Scherer 1970).

Day, Shocker and Srivastava (1979) have pointed out several shortcomings of using cross-price elasticity measures for identifying substitutes; as discussed earlier, the same criticisms also apply for identifying complements. Foster (1992) has recommended using scanner-panel data to identify substitutes and complements. Recent technological advances related to the gathering of scanner-panel data have spurred development of "data-reduction" techniques, designed to make the vast amounts of data manageable. Nevertheless, the complaint that retailers are "drowning in data" is common. The method developed in Chapter 4, used in conjunction with scanner-panel data may be a good way of overcoming this problem of data-overload. Thus, it may be worthwhile for market researchers to identify the cognitive structures for shoppers, and then verify the cognitive relationships by scanner-panel data, as a quick way to identify salient complementarities. Note that using scanner-generated data in the absence of such a cognitive technique may be next to impossible because of the sheer number of cross-price elasticities that would need to be calculated to make meaningful decisions¹.

Research in the past has primarily focused on identifying and studying substitutes. However, the methods developed in this dissertation may be usefully applied for the identification and study of complements, which may have important strategic implications for manufacturers in terms of product development, cross-promotions, alliances and bundling, to name just a few). Such study would also be useful from the point of view of

¹For instance, Berman and Evans (1992) state that many supermarkets stock over 15,000 items each. Calculation of all possible cross-price elasticities for a data set of this size would entail over 100 million calculations!

retailers, as it would help them serve consumer needs better by judicious shelf-allocation, cross-promotions, and price-bundling. Furthermore, the schema theory developed here may provide an explanation for the success of "niche" retail formats -- small specialty stores that carry assortments representative of a typical schema (e.g. shops that exclusively carry ski equipment, or undersea diving equipment) are a good example. Thus, schema-generation method may also be useful to retailers in deciding the formats to be used (by figuring out the frequency of schema-generation among their customers, for instance).

Several hypotheses important from a managerial as well as theoretical view-point may be answerable by extensions of this research. For example, when cross-couponsing, which item (out of a complementary pair) should be promoted? Under what circumstances would the answer to this question change? Are there asymmetries in the cognitive structures that explain asymmetries between complements? The answers to these questions will provide important implications for retail practitioners as well as researchers.

In addition, the research reported herein lends itself directly to the replication and extension of recent work in consumer behavior that had focused on substitutes. For instance, Burke and Srull (1988) showed that ads for "similar" products were more likely to cause interference-induced forgetting as compared to ads for "less-similar" products. A careful analysis of the stimuli show that they were substitutes in the "similar" condition and independents in the "less similar" condition. Since complements seem to have a schematic representation in memory, it is quite likely that the rich inter-item linkages inherently present in schemas will actually help recall, so that judicious placement of ads for complements (other things being equal), may well provide a way of overcoming interference-induced forgetting. (Also, exposure to complements may increase the perceived utility of a particular schema, thereby making the products easier to recall.)

Such strategies may have the potential to significantly reduce the adverse impact of advertising clutter on TV viewers' ad attention and recall. Thus, firms such as Procter and Gamble which advertise a myriad products (some of them complementary to one another,

some substitutes, and some unrelated) may consider buying large chunks of air-time so as to be able to air chunks of complementary ads. However, more research needs to be conducted to assess such strategies before they can be firmly recommended.

In conclusion, this dissertation provides a new paradigm for the study of substitutes and complements, based on a cognitive representation model. Two experiments supported this model, which has useful applications to both practitioners and academics. It is hoped that the model will lead to an increased interest in the study of complementarity, leading to greater insight into consumer behavior and the practice of marketing.

APPENDIX A
SCHEMAS IDENTIFIED BY SUBJECTS

GRADUATION PARTY
GOING SWIMMING (AT THE BEACH)
THANKSGIVING DINNER
GOING TO A PICNIC
PLAYING TENNIS
PRE-FOOTBALL GAME PARTY
GOING FISHING
'TURNING 21' PARTY
GOING CAMPING
OFFICE FURNITURE
FALL WARDROBE (FOR WOMEN)
IBM-PC COMPATIBLE EQUIPMENT
PROFESSIONAL ATTIRE (FOR MEN)
DINNER AT A FANCY RESTAURANT
FIRST-AID KIT
SCHOOL SUPPLIES
ENTERTAINMENT SYSTEM
WOMEN'S MAKE-UP KIT

APPENDIX B
PHASE 2 INSTRUCTIONS

In this study, you will be asked to generate usage situations and types of products used within the situations. For example, consider the situation: "Going Camping".

Now try to come up with types of products that you might use when going camping, as shown below:

Situation	Product Type
Going Camping	Tent/Shelter
"	Light
"	Beer
"	Food (Dinner)
"	Food (Snacks)
"	Sodas
"	Diet Sodas

Other examples might include: going to the beach, having a graduation party, having a 'turning 21' party, thanksgiving, going fishing, playing tennis, going on a picnic, etc.

General instructions: Note that this is only an example. You may use a different set of products when you go camping, and this might depend on other things, such as whether you plan on camping for a day, or for a week, etc. If this is the case, you should give the example that comes to mind (say, going camping for a weekend) and fill in the rest accordingly. Be specific!

Also, each 'product type' should be a separate category.

Say, for instance, that in the category 'Light', you would use both, a Coleman Lantern, and a Flashlight. In that case, you should try to break up the category into sub-categories (e.g. Portable Light' for flashlight, and 'camp light' for coleman lantern'.

WHEN YOU HAVE FINISHED READING THESE INSTRUCTIONS, YOU MAY
BEGIN. IF YOU HAVE ANY QUESTIONS, YOU MAY ASK THEM AT ANY TIME.
USE BOTH SIDES OF EACH SHEET. AND THANK YOU FOR PARTICIPATING!

APPENDIX C PHASE 3 INSTRUCTIONS

In this study, you will be given usage situations, along with types of products used in these situations. For example, consider the situation: 'Going Camping'. Previous studies indicate that Tent, Flashlight, Matches, Sleeping Bag, and Beer are some commonly used products when going camping.

Given this information, your task is to give specific and appropriate examples for each product type (and situation). Remember to provide at least two alternatives wherever possible, as shown:

Situation	Product Type	Specific Examples
Going Camping	Tent/Shelter	2 person tent or pup tent or dome tent
"	Soda	Coke or Pepsi or Mountain Dew
"	Matches	Book Matches or Safety Matches
"	Sleeping Bag	Nylon or Cotton
"	Bug Spray	Off! or Cutters
"	Flashlight	Plastic or Metal
"	Beer	Coors or Budweiser or Busch

WHEN YOU HAVE FINISHED READING THESE INSTRUCTIONS, YOU MAY BEGIN. IF YOU HAVE ANY QUESTIONS, YOU MAY ASK THEM AT ANY TIME. USE BOTH SIDES OF EACH SHEET. AND THANKYOU FOR PARTICIPATING!

APPENDIX D
USAGE SITUATIONS--ALL STIMULI

SCHEMA (& Corresponding Anchor):	Predicted Substitute	Predicted Complement	Predicted Independent
Graduation Party Anchor 1: Chocolate Cake	Vanilla Cake	Latex Balloons	Oakley's Sunglasses
Going Swimming (at the Beach) Anchor 1: Beach Towel	Bath Towel	Oakley's Sunglasses	Homemade Stuffing
Typical Thanksgiving Dinner Anchor 1: Butterball Turkey	Louis Rich Turkey	Homemade Stuffing	Plastic Basket
Going on a Picnic Anchor 1: Wicker Basket	Plastic Basket	Woollen Blanket	Prince Ten. Racquet
Playing Tennis Anchor 1: Wilson Tennis Ball	Penn Tenn. Ball	Prince Ten. Racquet	Lay's Pot. Chips
Pre-Football Game Party Anchor 1: Budweiser Beer	Bud Light Beer	Lay's Pot. Chips	Plastic Tackle Box
Going Fishing Anchor 1: Cane Fishing Pole	Fishing Rod & Reel	Plastic Tackle Box	Clothes (as a gift)
'Turning 21' Party Anchor 1: Chocolate Cake	Ice Cream Cake	Clothes (as a gift)	Nylon Sleeping Bag
Going Camping Anchor 1: Metal Flashlight	Plastic Flashlight	Nylon Sleeping Bag	Latex Balloons

CONTINUED

USAGE SITUATIONS--ALL STIMULI (continued)

SCHEMA (& Corresponding Anchor):	Predicted Substitute	Predicted Complement	Predicted Independent
Graduation Party Anchor 2: Helium Balloons	Latex Balloons	Vanilla Cake	Bath Towel
Going Swimming(@ the Beach) Anchor 2: Ray Ban Sunglasses	Oakley's Sunglasses	Bath Towel	Louis Rich Turkey
Typical Thanksgiving Dinner Anchor 2: Stove Top Stuffing	Homemade Stuffing	Louis Rich Turkey	Plastic Basket
Going on a Picnic Anchor 2: Cotton Blanket	Woollen Blanket	Plastic Basket	Penn Tennis Ball
Playing Tennis Anchor 2: Wilson Ten. Racquet	Prince Ten. Racquet	Penn Tennis Ball	Bud Light Beer
Pre-Football Game Party Anchor 2: Ruffles Pot. Chips	Lay's Pot. Chips	Bud Light Beer	Fishing Rod & Reel
Going Fishing Anchor 2: Metal Tackle Box	Plastic Tackle Box	Fishing Rod & Reel	Ice Cream Cake
'Turning 21' Party Anchor 2: Money (as a gift)	Clothes (as a gift)	Ice Cream Cake	Plastic Flashlight
Going Camping Anchor 2: Cotton Sleeping Bag	Nylon Sleeping Bag	Plastic Flashlight	Vanilla Cake

APPENDIX E
PARTONOMIES--ALL STIMULI

SCHEMA (& Corresponding Anchor):	Predicted Substitute	Predicted Complement	Predicted Independent
Office Furniture Anchor 1: Metal Desk	Wood Desk	Wood Filing Cabinet	9-West Shoes
Fall Wardrobe (for Women) Anchor 1: V-neck Sweater	Cardigan	9-West Shoes	Mouse - Packard Bell
IBM-PC Compatible Equipment Anchor 1: Keyboard - IBM	Keyboard - Packard Bell	Mouse - Packard Bell	Seiko Watch
Professional Attire (for Men) Anchor 1: Rolex Watch	Seiko Watch	Striped Tie	Chocolate Mousse
Dinner at a Fancy Restaurant Anchor 1: Red Wine	White Wine	Chocolate Mousse	Curad - Band-Aid
First-Aid Kit Anchor 1: J&J Gauze	Eckerd - Gauze	Curad - Band-Aid	Mechanical Pencils
School Supplies Anchor 1: #2 Pencils	Mechanical Pencils	Bic Pens	Panasonic VCR
Entertainment System Anchor 1: Sony TV	RCA TV	Panasonic VCR	Maybelline Blush
Women's Make-up Kit Anchor 1: Maybelline Lipstick	Revlon Lipstick	Maybelline Blush	Wood Filing Cabinet

PARTONOMIES--ALL STIMULI (continued)

SCHEMA (& Corresponding Anchor):	Predicted Substitute	Predicted Complement	Predicted Independent
Office Furniture Anchor 2: Metal Filing Cabinet	Wood Filing Cabinet	Wood Desk	Cardigan
Fall Wardrobe (for Women) Anchor 2: Bass Shoes	9-West Shoes	Cardigan	Keyboard - Packard Bell
IBM-PC Compatible Equipment Anchor 2: Mouse - IBM	Mouse - Packard Bell	Keyboard - Packard Bell	Striped Tie
Professional Attire (for Men) Anchor 2: Polo Tie	Striped Tie	Seiko Watch	White Wine
Dinner at a Fancy Restaurant Anchor 2: Cheesecake	Chocolate Mousse	White Wine	Eckerd Gauze
First-Aid Kit Anchor 2: J&J Band-Aid	Curad Band-Aid	Eckerd Gauze	Bic Pens
School Supplies Anchor 2: Peppermint Pens	Bic Pens	Mechanical Pencils	RCA TV
Entertainment System Anchor 2: Magnavox VCR	Panasonic VCR	RCA TV	Revlon Lipstick
Women's Make-up Kit Anchor 2: Covergirl Blush	Maybelline Blush	Revlon Lipstick	Wood Desk

APPENDIX F
SAMPLE INSTRUCTIONS FOR EXPERIMENT ONE--DERIVED UTILITY RATIOS

In this experiment, we are interested in assessing the value of different 'collections' of products. With this objective, you will be provided with 3 different sets of products for each type of collection. The first set is rated at **1000 points**; you have to rate the other two sets. For example, consider the three sets shown below for the collection:

Items in a Toolbox:

<u>Set 1</u>	<u>Set 2</u>	<u>Set 3</u>
Screws	Screws	Srews
Screwdrivers	Screwdrivers	Screwdrivers
Tape Measure	Tape Measure	Tape Measure
Bolts	Bolts	Bolts
Saw	Saw	Saw
Pliers	Pliers	Pliers
Nails	Nails	Nails
Drill	Drill	Drill
	Hammer (Craftsman)	Hammer (Craftsman)
		Lipstick (Revlon)
1000 Points	_____ Points	_____ Points

Thus, in set 1, you have the items shown in the left column above. Taken together, these items are worth 1000 points for a toolbox. Note that Set 2 has all the items in Set 1 *plus* a

Hammer (Craftsman), and Set 3 has all the items in Set 1 *plus* a **Hammer (Craftsman) *plus* Lipstick (Revlon)**.

Hence, be sure that you assign a rating equal to or greater than the rating of the previous set. For example, since set 1 is fixed at 1000 points, set 2 has to be given 1000 points or more, and set 3 has to be given a rating equal or greater than the rating given to set 2.

APPENDIX G
SAMPLE INSTRUCTIONS FOR EXPERIMENT ONE--SEMANTIC RATINGS

In this second part of the study, you will be asked to judge the relationship between given pairs of products in a particular context. Specifically, you will be asked to determine whether two products are: (1) Substitutes or (2) Complements or (3) Independent goods.

You probably recall these terms from your introductory economics courses. Just in case you don't:

Substitutes: Two (or more) goods may be defined as substitutes when people use one or the other good for achieving the same goal. For instance, if you were hungry and decided to order a pizza, then a pizza from Domino's versus a pizza from Pizza Hut would be substitutes, because you could satisfy your craving for pizza from either place. Thus, the presence of one good reduces the need for the other good when the two goods are substitutes.

Complements: Two (or more) goods may be defined as complements when they are all (collectively) desirable for achieving the same goal. For instance, many people like to drink beer when eating pizza - that is, the experience of eating pizza is in some way enhanced by drinking beer during the same occasion. Thus, Beer and Pizza would be complements for these folks. Similarly, one needs a Hammer and a Nail to hang a picture on the wall. Thus, for this goal (hammering a nail into the wall to put up a picture), a hammer and a nail are complements.

Independent goods: In some cases, neither of the above (substitutes or complements) seems to describe the relationship between goods. Such goods are known as independent goods. For example, it is difficult to think of a relationship between a hammer and a pizza (in the context of eating a pizza); most people would consider these two goods to be independent.

Each page that follows presents a pair of goods in a particular collection. You will have to judge the relationship between the goods in the context of the given collection.

For example:

In the collection: Items in a Toolbox,

which of the following best describes the relationship between **Hammer (Craftsman)** and **Lipstick (Revlon)**:

(Circle the appropriate number):

- +4 **Complements** - "both Hammer (Craftsman) *and*
Lipstick (Revlon)"
- +3
- +2
- +1
- 0 **Independent** - "no relationship"
- 1
- 2
- 3
- 4 **Substitutes** - "either Hammer (Craftsman) *or*
Lipstick (Revlon)"

Thus, if you think that Hammer (Craftsman) and Lipstick (Revlon) enhance one another, then you should circle a positive number. If you think that the relationship is strongly complementary, then circle +4. If, however, you think that the presence of one good reduces the need for the other, then circle a negative number. If the presence of one item makes the other totally unnecessary, then circle -4. Similarly, if you think that the two items are unrelated in the given collection, then circle 0. Note that the relationships between the products may change depending on the collection, so pay attention to the collection!

IF YOU HAVE ANY QUESTIONS, FEEL FREE TO ASK THEM AT ANY TIME. YOU MAY BEGIN AFTER READING THESE INSTRUCTIONS - AND THANK YOU FOR PARTICIPATING!

APPENDIX H
STIMULI USED IN EXPERIMENT TWO

PAIR	SUBSTITUTE CONTEXT	COMPLEMENT CONTEXT
GRANOLA & PEANUTS	A SNACK	TRAIL MIX
ICE-CREAM & COOKIES	AFTER DINNER SNACK	ICE-CREAM SANDWICH
SHRIMP & CLAMS	A DINNER ENTREE	SEA-FOOD GUMBO
TAPES & CDs	LISTENING TO MUSIC	TAPING FROM CDs
CARROTS & CELERY	VEG. DISH WITH DINNER	PART OF A SALAD

APPENDIX I
STIMULI USED IN EXPERIMENT THREE

PAIR	SUBSTITUTE CONTEXT	COMPLEMENT CONTEXT
BEER & COLA	CHOOSING A BEVERAGE	THROWING A PARTY
PEANUT-BUTTER & JELLY	SOMETHING TO PUT ON TOAST	MAKING A SANDWICH
PIE & ICE-CREAM	CHOOSING A DESSERT	EATING PIE-A-LA-MODE
TV & RADIO	A FORM OF ENTERTAINMENT	AN AWAY FOOTBALL GAME
TV & STEREO	A FORM OF ENTERTAINMENT	WATCHING TV IN STEREO
JACKET & SWEATER	CLOTHING FOR A COOL DAY	CLOTHING FOR A 'FREEZING COLD' DAY
COFFEE & MILK	CHOOSING A BEVERAGE	COFFEE WITH CREAM
BANANAS & ICE-CREAM	AN AFTER-DINNER SNACK	BANANA SPLIT
KETCHUP & MAYONNAISE	A CONDIMENT FOR SANDWICHES	MAKING 1000 ISLAND DRESSING
PEN & PENCIL	A WRITING INSTRUMENT	CONTRASTING ON A DRAWN GRAPH
MOUNTAIN-BIKE & CAR	A MEANS OF TRANSPORT	GOING ON A NATURE TRAIL THROUGH THE MOUNTAINS (FAR AWAY)
ICE-CREAM & MILK	A SOURCE OF CALCIUM	MAKING A MILKSHAKE

APPENDIX I (continued)

PAIR	SUBSTITUTE CONTEXT	COMPLEMENT CONTEXT
BEER & WHISKEY	CHOOSING AN ALCOHOLIC DRINK	MAKING A 'BOILERMAKER'
RUM & VODKA	AN ALCOHOLIC DRINK	A LONG-ISLAND ICED-TEA
COKE & RUM	A BEVERAGE BEFORE DINNER	A MIXED DRINK
HAM & TURKEY	CHOOSING A SANDWICH MEAT	FIXING A CLUB SANDWICH
ORANGE JUICE & VODKA	CHOOSING A BEVERAGE	A 'SCREWDRIVER'

LIST OF REFERENCES

- Alba, J. W. and L. Hasher (1983), "Is Memory Schematic?" Psychological Bulletin, 93 (2), 203-31.
- Alba, J. W., J. W. Hutchinson and J. G. Lynch, Jr. (1991), "Memory and Decision Making," in Handbook of Consumer Behavior, Eds. T. S. Robertson and H. H. Kassirjian. Englewood Cliffs, NJ: Prentice-Hall, Inc.
- Anderson, J. R. (1983), The Architecture of Cognition. Cambridge, MA: Harvard University Press.
- Anderson, N. H. (1982), Methods of Information Integration Theory. New York, NY: Academic Press.
- Barsalou, L. W. (1982), "Context-independent and Context Dependent Information in Concepts," Memory and Cognition, 10 (1), 82-93.
- Barsalou, L. W. (1983), "Ad-hoc Categories," Memory and Cognition, 11 (3), 211-27.
- Barsalou, L. W. (1985), "Ideals, Central Tendency and Frequency of Instantiation as Determinants of Graded Structure," Journal of Experimental Psychology: Learning, Memory and Cognition, 11, 629-54.
- Barsalou, L. W. and J. W. Hutchinson (1987), "Schema-based Planning of Events in Consumer Contexts," in Advances in Consumer Research, (Vol. 14, pp. 114-118), Eds. M. Wallendorf and P. Anderson. Provo, UT: Association for Consumer Research
- Barsalou, L. W. and D. Sewell (1985), "Contrasting the Representation of Scripts and Categories," Journal of Memory and Language, 24, 646-65.
- Becker, G. S. (1976), Economic Approach to Human Behavior. Chicago: University of Chicago Press.
- Belk, R. W. (1975), "Situational Variables and Consumer Behavior," Journal of Consumer Research, 2 (3), 157-74.
- Berman, Barry and Joel Evans (1992), Retail Management: A Strategic Approach. New York: Macmillan.
- Betancourt, R. and D. Gautschi (1990), "Demand Complementarities, Household Production, and Retail Assortments," Marketing Science, 9 (2), 146-161.
- Brewer, W. F. and J. C. Treyens (1981), "Role of Schemata in Memory for Places," Cognitive Psychology, 13, 207-230.

- Burke, R. R. and T. Srull (1988), "Competitive Interference and Consumer Memory for Advertising," Journal of Consumer Research, 15 (1), 55-67.
- Carroll, J. D. and J. J. Chang (1970), "Analysis of Individual Differences in Multidimensional Scaling via an N-way Generalization of 'Eckert-Young' Decomposition," Psychometrika, 35, 283-319.
- Day, G. S., A. D. Shocker, and R. K. Srivastava (1978), "Identifying Competitive Product-Markets: A Review of Customer Oriented Approaches," Working Paper, Department of Management Studies, University of Toronto, Toronto.
- Day, G. S., A. D. Shocker, and R. K. Srivastava (1979), "Customer Oriented Approaches to Identifying Product Markets," Journal of Marketing, 43 (4), 8-19. .
- Deaton, A. (1979), "The Distance Function in Consumer Behavior with Applications to Index Numbers and Optimal Taxation," Review of Economic Studies, 46, 391-406.
- Dickson, P. R. (1982), "Person-Situation: Segmentation's Missing Link," Journal of Marketing, 46 (4), 56-64.
- Edgeworth, F. Y. (1925), "Theory of Political Economy," in Papers Relating to Political Economy, (Vol.I, pp.) Ed. F. Y. Edgeworth. London: Macmillan. (This paper was originally published in 1897)
- Fennell, G. (1978), "Perceptions of the Product-Use Situation," Journal of Marketing, 42 (2), 39-47.
- Fisher, I. (1892,1925), Mathematical Investigations in the Theory of Value and Prices. Transactions of the Connecticut Academy, IX. New Haven: Yale University Press.
- Folse, Henry. J. (1985), The Philosophy of Niels Bohr: The Framework of Complementarity. New York: North-Holland.
- Foster, Irene Raj (1992), "The Cross-Couponing of Complements, Substitutes and Independent Goods," Working Paper, Department of Economics and Business Administration, Vanderbilt University, Nashville, TN.
- Georgescu-Roegen, N. (1952), "A Diagrammatic Analysis of Complementarity," Southern Economic Journal, 19 (1), 1-20.
- Graesser, A. and G. V. Nakamura (1982), "The Impact of a Schema on Comprehension and Memory", in The Psychology of Learning and Motivation, (Vol. 16, pp. 59-109), Ed. G. H. Bower. Hillsdale, NJ:Erlbaum.
- Gutman, J. (1982), "A Means-End Chain Model of Consumer Categorization Processes," Journal of Marketing, 46 (2), 60-72.
- Henderson, J. M. and R. E. Quandt (1958), Microeconomic Theory: A Mathematical Approach, New York: McGraw Hill.
- Hicks, J. R. and R. G. D. Allen (1981), " A Reconsideration of the Theory of Value," Wealth and Welfare, Ed. J. R. Hicks. Cambridge, MA: Harvard University Press. (Original work published 1934)

- Holbrook, M. B. and D. R. Lehmann (1981), "Allocating Discretionary Time: Complementarity Among Activities," Journal of Consumer Research, 7 (4), 395-406.
- Hutchinson, J. W., K. Raman, and M. K. Mantrala (1994), "Finding Choice Alternatives in Memory: Probability Models of Brand Name Recall," Working Paper, Department of Marketing, University of Florida, Gainesville.
- Johnson, M. D. (1984), "Comparable Choice Strategies for Comparing Noncomparable Alternatives," Journal of Consumer Research, 11 (3), 741-53.
- Johnson, W. E. (1913), "The Pure Theory of Utility Curves," Economic Journal, 23, 483-513.
- Keppel, G. (1991), Design and Analysis, Englewood Cliffs, NJ: Prentice-Hall.
- Lancaster, K. J. (1966), "A New Approach to Consumer Theory," Journal of Political Economy, 74, 132-57.
- Lancaster, K. J. (1971), Consumer Demand: A New Approach. New York: Columbia University Press.
- Lattin, J. and L. McAlister (1985), "Using a Variety-Seeking Model to Identify Substitute and Complementary Relationships Among Complementary Products," Journal of Marketing Research, 22 (3), 330-39.
- Lutz, R. J. and P. K. Kakkar (1975), "The Psychological Situation as a Determinant of Consumer Behavior," in Advances in Consumer Research (Vol. 3, 370-378.) Ed. B. B. Anderson. Chicago: Association for Consumer Research.
- Mandler, J. (1984), Stories, Scripts, and Scenes: Aspects of Schema Theory. Hillsdale, NJ: Erlbaum.
- Markman, E. (1981), "Two Different Principles of Conceptual Organization," in Advances in Developmental Psychology (Vol.1, 199-236.) Eds. M. Lamb and A. L. Brown. Hillsdale, NJ: Erlbaum.
- Minsky, M. (1975), A Framework for Representing Knowledge, in The Psychology of Computer Vision, Ed. P. H. Winston. New York: McGraw Hill.
- Mosak, J. L. (1944), General Equilibrium Theory in International Trade. Cowles Commission for Research in Economics, Monograph Number 7. Bloomington, IN: Principia Press.
- Mulhern, F. J. and R. P. Leone (1991), "Implicit Price Bundling of Retail Products: A Multiproduct Approach to Maximizing Store Profitability," Journal of Marketing, 55 (4), 63-76.
- Nedugandi, P. (1990), "Recall and Consumer Consideration Sets: Influencing Choice Without Altering Brand Evaluations," Journal of Consumer Research, 17 (3), 263-76.
- Neisser, U. (1976), Cognition and Reality. San Francisco: W. H. Freeman.

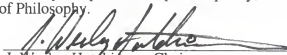
- Nelson, K. (1977), "Cognitive Development and the Acquisition of Concepts," in Schooling and the Acquisition of Knowledge. (pp. 215-240). Eds. R. C. Anderson, R. J. Spiro, and W. E. Montague. Hillsdale, NJ: Erlbaum.
- Newman, P. (1987), "Substitutes and Complements," in The New Palgrave: A Dictionary of Economics, (vol. 4, pp. 545-8). Eds. J. Eatwell, M. Milgate and P. Newman. London: Macmillan.
- Pareto, V. (1927), Manuel d'economie politique. Paris: Marcel Giard.
- Park, C. W. and G. Zaltman (1988), Marketing Management. New York: Dryden Press.
- Ratneshwar, S. and A. D. Shocker (1991), "Substitution-in-use and the Role of Usage Context in Product Category Structures," Journal of Marketing Research, 28 (3), 281-95.
- Rumelhart, D. E. (1980), "Schemata: The Building Blocks of Cognition," in Theoretical Issues in Reading Comprehension: Perspectives from Cognitive Psychology, Linguistics, Artificial Intelligence and Education. (pp. 33-58). Eds. R. J. Spiro, B. C. Bruce, and W. F. Brewer. Hillsdale, NJ: Erlbaum.
- Rumelhart, D. E. and A. Ortony (1977), "The Representation of Knowledge in Memory," in Schooling and the Acquisition of Knowledge. (pp. 99-136). Eds. R. C. Anderson, R. J. Spiro, and W. E. Montague. Hillsdale: Erlbaum.
- Samuelson, P. (1974), "Complementarity: An Essay on the 40th Anniversary of the Hicks-Allen Revolution in Demand Theory," Journal of Economic Literature, 12, 1225-89.
- Schank, R. C. and R. P. Abelson (1977), Scripts, Plans, Goals, and Understanding. Hillsdale, NJ: Erlbaum.
- Scherer, F. (1970), Industrial Market Structure and Economic Performance. Chicago: Rand McNally
- Shepard, R. N. (1962), "The Analysis of Proximities: Multidimensional Scaling with an Unknown Distance Function," Psychometrika, 27, 125-40, 219-246.
- Slutsky, E. E. (1951), "On the Theory of the Budget of the Consumer," in Readings in Price Theory. (pp. 27-56). Eds. K. Boulding and G. Stigler. London: George Allen and Unwin Limited. (Original work published 1915)
- Srivastava, R. K., R. P. Leone, and A. D. Shocker (1981), "Market Structure Analysis: Hierarchical Clustering of Products Based on Substitution-in-Use," Journal of Marketing, 45 (3), 38-48.
- Srivastava, R. K., M. I. Alpert, and A. D. Shocker (1984), "A Customer-Oriented Approach for Determining Market-Structures," Journal of Marketing, 48 (2), 32-45.
- Stigler, G. J. (1965), Essays in the History of Economics. Chicago: University of Chicago Press.

- Taylor, S. E. and J. Crocker (1981), "Schematic Bases of Social Interaction Processing," in The Ontario Symposium on Personality and Social Psychology. Eds. E. T. Higgins, P. Herman and M. P. Zanna. Hillsdale, NJ: Erlbaum.
- Tversky, B. and K. Hemenway (1984), "Objects, Parts and Categories," Journal of Experimental Psychology: General, 113, 170-193.
- Vardarajan, P. R. (1986), "Horizontal Cooperative Sales Promotion: A Framework for Classification and Additional Perspectives," Journal of Marketing, 50 (2), 61-73.
- Winston, M. E., R. Chaffin, and D. Hermann (1987), "A Taxonomy of Part-Whole Relations," Cognitive Science, 11, 417-44.
- Walters, R. G. (1991), "Assessing the Impact of Retail Price Promotions on Product Substitution, Complementary Purchase, and Interstore Sales Displacement," Journal of Marketing, 55 (2), 17-28.

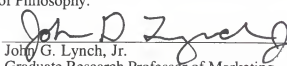
BIOGRAPHICAL SKETCH

Amitabh Mungalé was born in Bombay, after which he moved almost every other year for the next two decades. (In fact, Gainesville was the city where he lived for the longest continuous period of time!) Along the way, Amitabh picked up a bachelor's degree in pharmacy and worked in the pharmaceutical industry, following it up with an MBA in marketing and finance. Later, Amitabh joined the Ph.D. program in marketing at the University of Florida in Gainesville. He is currently an Assistant Professor of Marketing at Rutgers University at Newark, New Jersey.

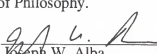
I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.


J. Wesley Hutchinson, Chairman
Associate Professor of Marketing

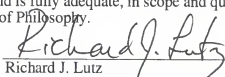
I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.


John G. Lynch, Jr.
Graduate Research Professor of Marketing

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.


Joseph W. Alba
Associate Professor of Marketing

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.


Richard J. Lutz
Professor of Marketing

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.


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This dissertation was submitted to the Graduate Faculty of the Department of Marketing in the College of Business Administration and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy .

August 1994

Dean, Graduate School